VIBRATION TEST EQUIPMENT

OPERATING AND SERVICING INSTRUCTIONS

MODEL OSP-4L

OSCILLATOR-SERVO-PROGRAMMER

SERIAL NUMBER 416

SPECIAL FEATURES AND NOTES:

OPTION: L, Recorder Output

File: U1

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UNHOLTZ-DICKIE CORPORATION

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SPECIAL FEATURE

Option "L" Recorder Output

1.1 LOG DC OUTPUT:

In this version of the OSP-4, provisions are made for a DC voltage output, proportional to the logarithm of the vibration level. This output is referenced to the settings of channel 4, where 0 dB gives 0 V DC, -20 dB gives -1 V, -40 dB gives -2 V and -60 dB gives -3 V.

1.2 RECORDER OUTPUT

1.2.1 Connect COMP OUT to 10 mV/g IN
Selector switch to 10 mV/g IN

1.2.2 Set

OSC	to 100 Hz
MAX OUT	to full CW
MAX SPEED	to 3k dB/Sec
CROSSOVERS	for active Segment 1
LEVEL VERNIERS	to 1.000 (10 turns)
FUNCTION SELECTORS	to ACC
MULTIPLIERS	to X1000 Segment 4
SERVO MODE	to LEVEL CAL

Monitor the REC. output with a digital DCVM.

1.2.3 Obtain readings in table 1.1 below:

MULTIPLIER SEGMENT 1	RECORDER OUTPUT V DC
X1000	0.000 ± .010 V
X100	-1.000 ± .010 V
X10	-2.000 ± .010 V
X1	-3.000 ± .025 V

TABLE 1.1

1.3 CALIBRATION/OPERATION WITH X-Y RECORDER

1.3.1 Signal Inputs and Output

Connect: (1) COMP OUT (OSP-4L) to Power Amplifier Inp
(2A) ACCELEROMETER to CHG IN (OSP-4L) with low noise cable OR:
(2B) 10 mV/g (Signal Conditioner) to 10 mV/g IN (OSP-4L)

SET: (3) CHG. IN/10 mV/g IN SELECTOR to appropriate position for (2A) or (2B)
(4A) SENS RANGE & DIAL for accelerometer sensitivity (2A only)

1.3.2 For X-Y Recording

Connect: (1) LOG DC (OSP-4L) to X-AXIS input
(2) REC (OSP-4L) to Y-AXIS input

1.3.3 The full scale value of segment 4 should be larger tha the highest vibration level for the test.

1.3.4 Choose a recording paper. This usually has log-lo scales with either 2 x 3 or 3 x 5 cycles.

1.3.5 Calibration of frequency Scales (X-AXIS)

Set frequency to lower limit. Use X-AXIS Zero Control to position the pen for the low limit frequency on the graph paper. Set frequency to upper limit. Use the X-Axis Gain Switch and Gain Vernier to position the pen for the high limit frequency on graph paper. Repe these steps until both points are accurately set.

1.3.6 Calibration of Amplitude Scale (Y-AXIS)

Set: FREQUENCY in midrange
SERVO MODE to LEVEL CAL
MAX OUT to FULL CW
FUNCTION SEL to ACC for the controlling segment, which is <u>not</u> segment 4.
LEVEL VERNIER to 1.000 (10 turns) for controlling segment

Set the LEVEL MULTIPLIER for the controlling segment to the same value as segment 4. Use the Y-AXIS Zero Control to position the pen for full scale amplitude output. Then set the LEVEL MULTIPLIER for the controlling segment a factor of 10 lower than that above and use the Y-AXIS Gain Switch and Gain Vernier to position the pen for -20 dB or 1 decade below full scale.

If another LEVEL MULTIPLIER is available with a factor of 10 less than the previous one, the position of -40 dB or 2 decades below full scale may be checked. Repeat above until pen positions are correct.

1.3.7 Then set up desired program.

1.4 Refer to Figures 7.45 and 7.46 for Recorder Output Circuitry.

1.5 AC - Log DC Converter - (F Card)

1.5.1 Balance AC-DC converter section -

Provide ZERO input to 10 mV/g IN
MULTIPLIER to X1000 on Segment 4
Short Pin F-6 to Ref. (Pin F-11)

Adjust B1 for a null at TP 1 using CRO, then adjust B2 for 0 V DC ±1 mV at Pin F-4. Repeat procedure until both TP 1 and F-4 show nulls. Remove short between F-6 and F-11.

1.5.2 Provide connections and settings as in 1.2.1 and 1.2.2. With the LEVEL MULTIPLIER in X1000 for Segment 1, adjust GAIN for 10.00 V DC output at Pin F-4.

1.5.3 Monitor DC voltage at RECORDER output. Take the readings and make adjustments in Table 1.2

below sequentially and repeat until readings agree with those in Table 1.1.

MULTIPLIER SEGMENT 1	RECORDER OUT	ADJUST
X1000	0.000	0 dB
X100	-1.000	30 dB
X1	-3.000	60 dB

TABLE 1.2
LOG CONVERTER CALIBRATION

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1. GENERAL DESCRIPTION

In a single compact chassis, the Model OSP-4 provides the means for signal generation, control, and measurement for a complete sinusoidal vibration test. It is compatible with all commercially available shaker-power amplifier combinations, and only an accelerometer is required to perform a complete vibration test. A typical test setup is shown in Fig. 1, in which optional instrumentation is shaded.

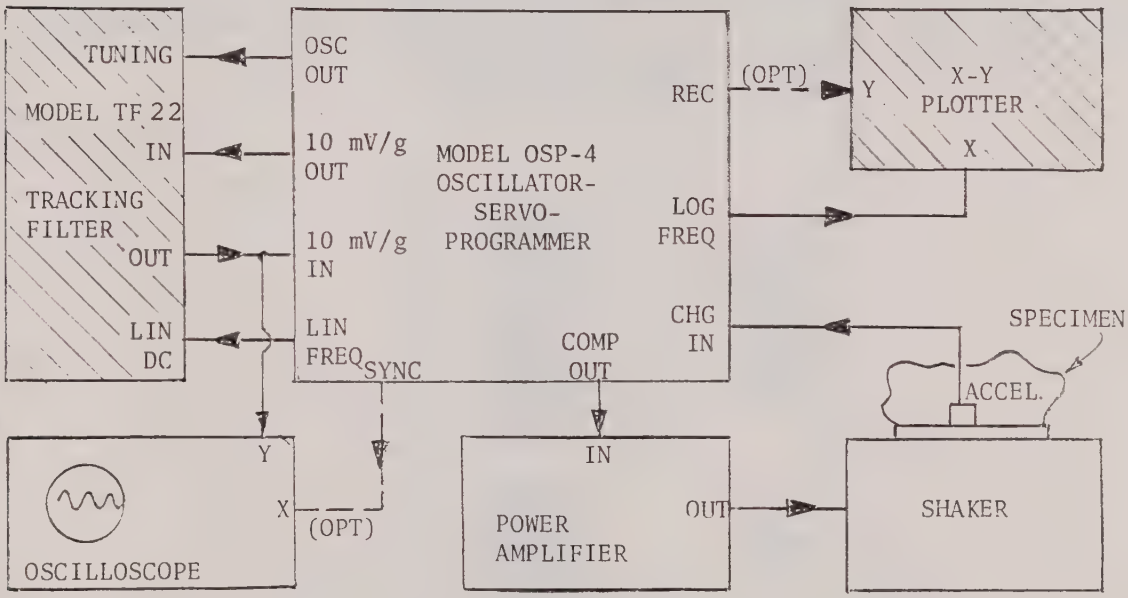


FIG. 1 TYPICAL SINUSOIDAL TESTING SYSTEM

The oscillator section digitally generates a constant amplitude, extremely low distortion, log-sweep sine wave. It contains most of the features of the U-D Model OSC-1 Sweep Sine Generator.

The servo section provides a compressor or AGC circuit of improved design, which gives zero static compression error instead of the heretofore typical 1 dB error for 60 dB gain variation. The servo-controlled compressor output voltage contains very little distortion, and the distortion does not increase with compressor speed. The turn-on time starting at low frequencies has been drastically reduced.

The programmer section provides for as many as four-segment programs. Push-button controls allow range selection and selection of displacement or acceleration for each segment. Tests in MIL-STD-810B and MIL-STD-331 are easily programmed. Segments of constant acceleration and constant displacement can be chosen in any

sequence, as the crossover frequencies are independently controlled. The ten-turn level vernier and locking dial allow the test levels to be set up without resorting to the usual "off-the-air" presetting procedure. The level verniers also do not require "touching-up" during the test.

The internal charge amplifier and sensitivity normalizer (Dial-A-Gain feature) allows almost any crystal transducer to be used directly with the OSP-4. This section may be bypassed if other instrumentation providing 10 mV/g is used.

Push-button front-panel control is utilized and the OSP-4 is fully compatible with other accessories such as the U-D Model TF22 Tracking Filter, Model MAC-8 Averaging Control, and Model ACS-6 Acceleration Control Selector.

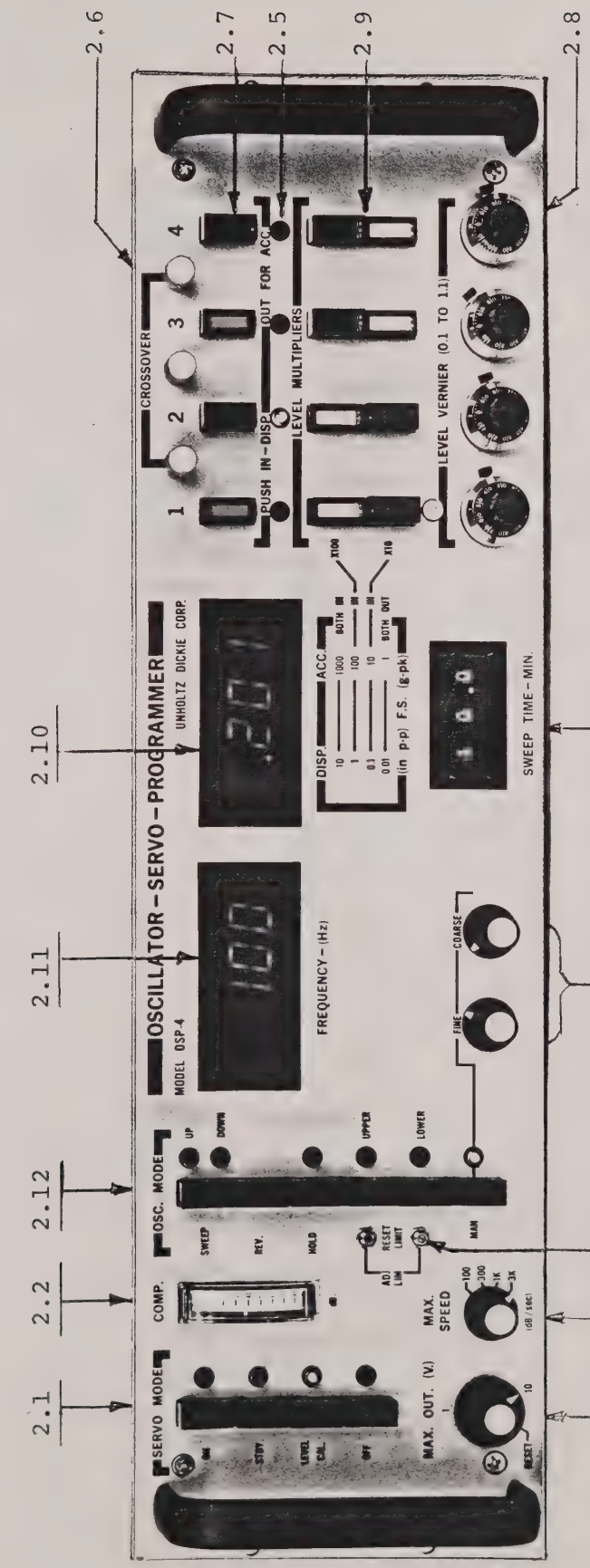


FIG 2.1
FRONT-PANEL CONTROLS WITH SECTION REFERENCES

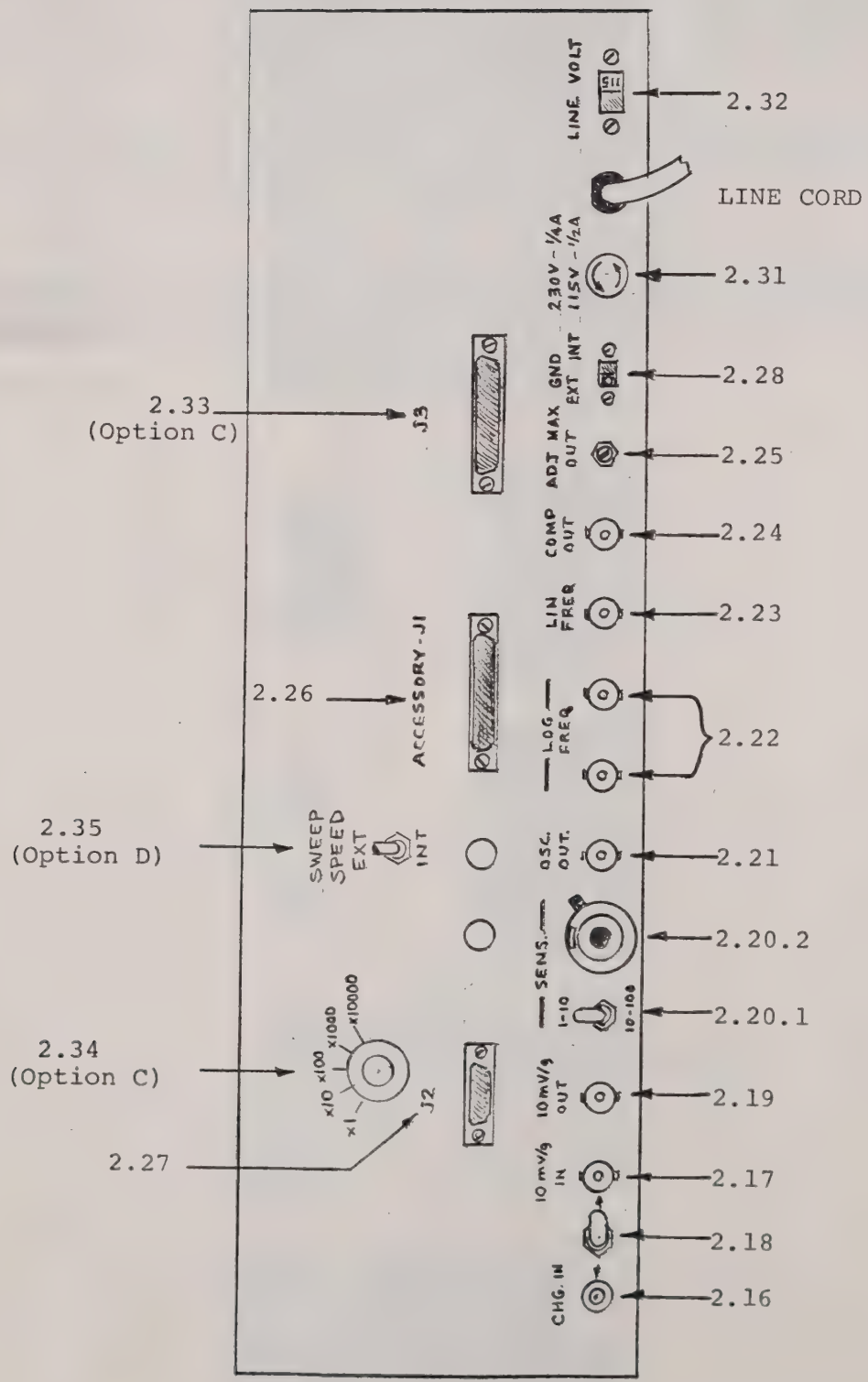


FIG. 2.2
REAR-PANEL CONTROLS AND CONNECTORS WITH SECTION REFERENCES

2. CONTROLS-CONNECTORS

Front-panel control locations for the Model OSP-4 are shown in Figure 2.1 and rear-panel control and connector locations are shown in Figure 2.2. All toggle switches are locking. Sections 2.1 through 2.15 relate to front-panel controls. Sections 2.16 through 2.32 relate to rear-panel controls or connectors.

2.1 SERVO MODE Switches and Indicators. The four switches are momentary-contact pushbuttons. The adjacent LED indicators show the active mode. Only one mode may be active at any one time.

2.1.1 ON - The associated red LED indicator shows that the amplitude servo is active and the vibration amplitude is under closed-loop control. The vibration level is determined by the programmer section.

Depressing the ON button momentarily when the servo is in the LEVEL CAL or OFF modes returns the servo to STBY. Keeping the ON button depressed allows the servo to cycle through the STBY mode to the ON mode. The COMPRESSOR SPEED is a continuous function of frequency in this mode.

2.1.2 STANDBY - The associated yellow LED indicator shows that the voltage at the COMPRESSOR OUTPUT jack is more than 80 dB below full output (< 1 mV rms). The vibration level for this condition is essentially zero.

Depressing the STBY button momentarily always returns the servo to the STBY mode. If the servo is in the ON, LEVEL CAL or OFF mode, depressing one of the other two buttons momentarily also returns the servo to the STBY mode. Interruption of any switch interlock returns the servo to STBY only for ON mode operation. When the servo enters the STBY mode, and the oscillator is in the SWEEP mode, the oscillator automatically goes to HOLD.

2.1.3 LEVEL CAL - The associated green LED indicator shows that this mode is active. The vibration amplitude in this mode is zero because no signal is transmitted to the power amplifier. The compressor output voltage is switched internally to the control input (10 mV/g IN.) so that closed-loop control is established around the OSP-4 only. In this fashion the OSP-4 operation can be checked and the calibration of the LEVEL VERNIERS and LEVEL MULTIPLIERS can occasionally be checked.

Depressing the LEVEL CAL button momentarily when the servo is in the ON or OFF modes returns the servo to STBY, but keeping the button depressed allows the servo to cycle through the STBY mode to the LEVEL CAL mode.

2.1.4 OFF - The associated red LED indicator shows that the amplitude servo is inactive and that the compressor (AGC) amplifier is in a maximum gain state. The voltage at the COMP OUT jack is determined by the MAX OUT control. Manual or open-loop vibration testing is conducted in the OFF mode.

To initiate the OFF mode, the OFF button must be depressed after the MAX OUT control has been returned to the RESET position. The servo will go to the STBY mode if the MAX OUT control is not in the RESET position, to prevent possible specimen damage.

2.2 COMPRESSION (dB) Meter - This is a vertical edge reading meter which indicates the amount of compression or gain decrease below the maximum gain of the compressor (AGC) amplifier. In the OFF mode the reading is 0 dB; the reading in the STBY mode is greater than 80 dB; the reading for the ON and LEVEL CAL modes is between 0 and 80 dB. The compression is proportional to the gain of the shaker and amplifier and the setting of the MAX OUT control for the ON mode.

2.3 MAX OUTPUT (V) - This logarithmic-taper potentiometer fixes the maximum output voltage that can be obtained from the COMP OUT jack for 0 dB compression. Approximate voltages are noted on the front panel.

The RESET position allows the OFF mode to be established, and the MAX OUT becomes a simple gain control for this mode. For the ON and LEVEL CAL modes, an increase in the setting of the MAX OUT control causes the COMPRESSION to increase. Generally the setting of the MAX OUT control in the ON mode for vibration testing should be high enough to cause compression to be greater than 0 dB for all frequencies. The setting should usually not be disturbed during a test.

2.4 MAX SPEED (dB/sec) - This four-position switch fixes the upper limit for the compressor speed variation in the ON and LEVEL CAL modes (closed-loop operation). The speed varies continuously from 10 dB/sec at 5 Hz to the indicated upper limit (100, 300, 1K, or 3K) at 5 kHz. The variation is a straight line on log-log coordinates. For most testing the 1K position works well. Very high Q specimen resonances, or operation with a MAC-8 may require a lower setting.

2.5 Program Segment Indicators - These red LED indicators are located between the A-D selectors and the RANGE MULTIPLIERS. The lighted indicator shows the active or controlling program segment.

2.6 CROSSOVER (frequency) - These ten-turn potentiometers are located between the A-D selectors. Each is used to adjust the frequency at which control shifts from the program segment on the left to the next applicable segment on the right. Complete CW rotation sets the frequency above the range of operation (> 5 kHz), and complete CCW rotation sets the frequency below the range of operation (< 5 Hz).

Thus, setting any crossover control Max CW prevents the next segment on the right from controlling the program. Setting any crossover control Max CCW prevents all segments to the left from controlling the program.

To adjust the crossover frequency from one program segment to an adjacent one at a particular frequency of operation(assuming one of the adjacent segments indicators is lighted), rotate the CROSSOVER control toward the active program segment. When switching takes place, rotate the control back and forth slowly until switching is accomplished with minimal control action.

2.7 ACCELERATION/DISPLACEMENT Selectors - The A-D selector pushbutton for each segment is located just above the corresponding LED indicator. Push the button in to select DISPLACEMENT, and push it again to release the button (out position) and select ACCELERATION. For DISP selection, the pushbutton indicates a green color. For ACC selection, the pushbutton color is black.

2.8 LEVEL VERNIERS - The LEVEL VERNIERS utilize ten-turn precision potentiometers with locking dials, and are located just below the LEVEL MULTIPLIERS. The dials allow the controlled amplitude to be set between 10% (dial setting = 1.0) and 110% (dial setting = 11.0) of the full scale ranges indicated in Section 2.9. The level may be dialed with a precision of 1% at a dial setting of 1.0 and a precision of 0.1% at a dial setting of 10.0.

No closed-loop presetting operation without the shaker operating is necessary to set the program levels, because of the precision LEVEL VERNIERS and the zero static error AGC amplifier. Touch up of the LEVEL VERNIERS during the test is also eliminated.

The LEVEL CAL mode may be used occasionally to check instrument calibration.

2.9 LEVEL MULTIPLIERS - The two LEVEL MULTIPLIER pushbuttons for each segment operate in binary fashion to provide four different ranges for either displacement or acceleration control. The multipliers are activated by pushing the button in, and the button is released by pushing it again. A white indicator shows the active multipliers. The ranges of adjustment are summarized below in Table 2.1.

RANGE MULTIPLIERS	NOMINAL FULL SCALE RANGE	
	ACC (g-pk)	DISP (in p-p)
BOTH IN	1000	10.00
X100 IN, X10 OUT	100.0	1000 mil
X100 OUT, X10 IN	10.00	100.0 mil
BOTH OUT	1.000	10.00 mil

Table 2.1 Full-Scale Ranges.

The information in Table 2.1 is also summarized below the VIBRATION METER on the front panel of the OSP-4.

2.10 VIBRATION METER - The 3½ digit display indicates the vibration level associated with the active program segment. The decimal point is determined automatically by the selection of the RANGE MULTIPLIERS and the A/D selector for the active segment. Refer to the Table 2.1 or to the table below the meter for the full scale range.

2.11 FREQUENCY INDICATOR - A four-digit LED display provides a direct reading of oscillator frequency from 5 to 5000 Hz to the nearest 1 Hz value. The display is updated 10 times/second.

2.12 OSCILLATOR MODE Switches and Indicators - Six pushbutton switches provide control of the oscillator. Indicator lights show the mode of operation. All buttons are momentary contact.

2.12.1 SWEEP - Depressing the momentary contact SWEEP button will initiate a logarithmic frequency sweep from any other mode. The green LED indicators show whether the oscillator frequency is going up or down. If the SWEEP mode is initiated from the MANUAL mode, the sweep will usually begin UP. If the manual frequency setting is above the UPPER LIMIT frequency, then the sweep will begin DOWN. If the SWEEP mode is actuated from the HOLD mode, the sweep direction will continue in the same direction which was in effect before the HOLD mode.

2.12.2 REVERSE - Depressing this momentary contact pushbutton changes the direction of the frequency sweep. When the oscillator is in the HOLD mode, pushing the REV button causes the sweep direction to be changed when the SWEEP button is finally pressed.

2.12.3 HOLD - Depressing the momentary contact HOLD button causes the sweep to stop at any point in the cycle. The associated yellow LED lights, and the oscillator will remain in the HOLD mode until another button is actuat The oscillator automatically goes to HOLD from the SWEE

mode, if the servo goes to STBY for any reason.

2.12.4 RESET LOWER - Depressing the RESET LOWER button rapidly sets the oscillator frequency to the lower limit frequency, which is determined by the setting of the LOWER LIMIT potentiometer.

When the oscillator is in the RESET DOWN mode, the desired setting of the LOWER LIMIT control may be made with the use of the digital FREQUENCY INDICATOR.

2.12.5 RESET UPPER-The action of the RESET UPPER button is similar to that of the RESET LOWER button except that the upper limit frequency is involved. The UPPER LIMIT control may easily be adjusted to provide the desired upper limit frequency in this mode.

2.12.6 MANUAL - Depressing the MANUAL button causes the oscillator frequency to be determined by the FINE and COARSE controls.

2.13 MANUAL Frequency Controls - The ten-turn COARSE control varies the frequency over a 3-decade range in the MAN mode. One turn varies the frequency over a 2:1 range. The single-turn FINE control varies the frequency over a 7% range.

2.14 Sweep LIMIT Controls

2.14.1 LOWER - The lower frequency limit may be set anywhere in the 3-decade frequency range. One turn on the control changes the frequency limit approximately 40%.

2.14.2 UPPER - The upper frequency limit may be set anywhere in the 3-decade frequency range, but electronic circuitry prevents it from being set lower than the lower limit. One turn of the control changes the upper limit approximately 40%.

2.15 SWEEP TIME - MIN Selector - This digital thumbwheel switch sets the time in minutes to sweep once between the lower and upper frequency limits. The sweep time may be accurately set between 1.0 and 99.9 minutes. Settings lower than 1.0 minute are limited in accuracy.

THE FOLLOWING SECTIONS RELATE TO REAR PANEL CONTROLS AND CONNECTORS. All connectors are isolated BNC, except where noted.

2.16 CHARGE INPUT - An insulated Microdot connector which accepts a signal directly from a piezoelectric accelerometer (or other piezoelectric transducer) at any sensitivity between 0.5 and

100 pC/g. It provides a control signal for the test, and no external signal conditioner is required.

2.17 10 mV/g INPUT - Accepts a control signal from an external signal conditioning amplifier or other accessory instrument, such as a U-D Model TF11 Tracking Filter, Model MAC-8 Signal Averager, or Model ACS-6 Acceleration Control Selector. The signal sensitivity is 10 mV/g.

2.18 CHG IN/10 mV/g Selector - A two-position, locking toggle switch which selects either of the possible control signal sources in 2.16 or 2.17.

2.19 10 mV/g OUT - Provides a normalized and conditioned 10 mV/g signal when the CHG IN is utilized. This allows external monitoring of the acceleration signal and also the use of a Model TF11 Tracking Filter without an external signal conditioner. See Section 3.1.3.

2.20 SENSITIVITY Normalization - These controls are used when the internal charge converter is used (CHG IN).

2.20.1 SENS RANGE - A two position locking toggle switch which provides two 10:1 sensitivity ranges: 1 to 10 pC/g and 10 to 100 pC/g.

2.20.2 SENS DIAL - A ten-turn precision potentiometer with a locking dial which allows settings from 0.50 to 10.50 to be dialed directly.

2.21 OSCILLATOR OUTPUT - Provides the constant 1 V rms sinusoidal output from the oscillator section over the 3 decade frequency range.

2.22 LOG FREQ - These two paralleled connectors provide a DC voltage proportional to the log of the frequency. The sensitivity is 0.4 V/decade with the output ranging from 0 to 1.2 V over the three decades.

2.23 LIN FREQ - Provides a DC voltage proportional to frequency. The sensitivity is 2 mV/Hz for the range of 5 to 5000 Hz.

2.24 COMPRESSOR OUTPUT - Provides the AGC signal to drive the power amplifier. The maximum output for 0 dB compression is determined by the MAX OUT control. With the MAX OUT full CW, a maximum output of 10 V rms is supplied.

2.25 ADJ MAX OUT - This potentiometer control is used to adjust the maximum output for system application so that maximum output from the COMP OUT jack will not damage the vibration exciter or amplifier. It is used primarily if maximum signal

input for a system is significantly less than 10 V rms.

2.26 ACCESSORY J1 - A 25 pin DBC-25-S connector provides the functions described in Table 2.2.

PIN	FUNCTION
1	Logic REFERENCE - Servo section
2	+5V DC Regulated - Short Circuit Protected.
3	
4	Momentary logic 0 will cause servo Standby mode
5	Momentary logic 0 will cause servo Level Cal mode*
6	Momentary logic 0 will cause servo On mode*
7	
8	
9	
10	
11	
12	
13	MAC-8 Multiplexing Control; Logic 0-ACC; Logic 1-DISP.
14	Momentary logic 0 will cause Reversal of oscillator sweep
15	Momentary logic 0 will cause Sweep oscillator mode
16	Momentary logic 0 will cause Hold oscillator mode
17	Momentary logic 0 will cause Reset Up oscillator mode
18	Momentary logic 0 will cause Reset Down oscillator mode
19	Momentary logic 0 will cause Manual oscillator mode
20	Logic reference - Oscillator section
21	
22	
23	
24	
25	

Table 2.2 Accessory Connector Pin Functions - J1

2.27 Connector J2 - A DEC-9S connector with the following functions:

PIN	FUNCTIONS
1	Jumpered to pin 2 or through NC external interlocks
2	Logic REFERENCE
3	NC when MAX OUT control is out of RESET position. Used for power amplifier interlock
4	

2.28 GND EXT-INT - A two-position slide switch which connects the signal reference to chassis in the INT position. In the EXT position, signal reference and chassis are isolated. It is assumed that the connection is made externally in another instrument for the latter condition.

* Action is inhibited for approximately 2 seconds after initiation of servo Standby mode.

2.29 SYNC (Optional) - Provides a ramp output of approximately 10 V p-p at 1/3 the oscillator frequency. When applied to the X axis of an oscilloscope exactly 3 cycles of the fundamental frequency are displayed.

2.30 RECORDER (Optional) - Provides a DC voltage proportional to the log of the vibration level. Full scale range and function selection is determined by the settings for Segment 4. Output has 60 dB range for 1000 g setting. Full scale is 0 V DC and sensitivity is 50 mV/dB (1 V/decade).

2.31 FUSE - Cartridge fuse 1/2A for 115 V AC; 1/4A for 230 V AC line voltage.

2.32 LINE VOLT - A screwdriver-actuated selector switch for operation from 105-125 V AC (115V) or 210-250 V AC (230V) line voltage. Power line frequency is 50 to 60 Hz.

3. OPERATION

3.1 INSTRUMENT AND SYSTEM CONNECTIONS - Refer to Fig. 1 or the appropriate U-D interconnection drawing accompanying the U-D Vibration Test System.

3.1.1 Signal Input and Output.
Connect COMP OUT (OSP-4) to Power Amplifier Input. If the internal charge amplifier is used, connect the accelerometer output to the CHG IN (OSP-4) using low-noise (treated) cable. Make sure the rear panel INPUT SELECTOR switch points toward the CHG IN connector.

If an external charge amplifier or other 10 mV/g source is used (Model MAC-8, Model ACS-6, Model TF11) connect this to the 10 mV/g INPUT, and switch INPUT SELECTOR toward 10 mV/g IN.

3.1.2 For X-Y Recording
Connect: LOG FREQ (OSP-4) to X-Axis input.
RECORDER (OPTIONAL) to Y-Axis input.

3.1.3 With Model TF11 Tracking Filter.
Connect: (1) OSC OUT (OSP-4) to TUNING (TF11)
(2) OUT (TF11) to 10 mV/g IN (OSP-4)
(3) LIN FREQ (OSP-4) to LIN DC (TF11)
(4) 10 mV/g OUT (OSP-4) to IN (TF11)
(5) ACCELEROMETER to CHG IN (OSP-4)
Set: INPUT SELECTOR to 10 mV/g IN (OSP-4)

If the tracking filter is used with an external charge amplifier, connect the 10 mV/g output to the IN (TF11) and eliminate connections (4) and (5) above.

3.1.4 With Model MAC-8 Signal Averager
Connect: J1-1 (OSP-4) to Accessory-14 (MAC-8)
J1-13(OSP-4) to Accessory-19 (MAC-8)
J2-1 (OSP-4) to Accessory-12 (MAC-8)
J2-2 (OSP-4) to Accessory-13 (MAC-8)

(Above may be in a single cable assembly)

SERVO (10 mV/g-Signal Conditioners) to Inputs 1-8(MAC-8)
OUT 1 (MAC-8) to 10 mV/g IN (OSP-4)
OSC OUT (OSP-4) to SINE IN (MAC-8)

Refer also to MAC-8 Instruction Manual.

3.1.5 With Model ACS-6 Acceleration Control Selector
Connect: J1-1 (OSP-4) to J3-6 (ACS-6)
J1-13(OSP-4) to J3-1 (ACS-6)
J1-2 (OSP-4) to J3-2 (ACS-6)
J2-1 (OSP-4) to J3-5 (ACS-6)
J2-2 (OSP-4) to J3-3 (ACS-6)
J2-1 (ACS-6) to J2-2 (ACS-6)

(Above may be in a single cable assembly.)

SERVO (10 mV/g Signal Conditioners) to ACCEL IN 1 thru 6 (ACS-6
LOG FREQ (OSP-4) to LOG FREQ IN (ACS-6)
OUTPUT (ACS-6) to 10 mV/g IN (OSP-4)

3.1.6 Interlocks
Make sure that the interlock cable supplied with the system is firmly connected to each system instrument. If operation of the OSP-4 is desired without a cable connection to rear panel connector J2, a jumper between pins 1 and 2 is necessary to get the OSP-4 out of the STBY mode. The normally closed interlock circuits of other instruments are put in series with pins 1 and 2. Pins 3 and 4 are used to provide an interlock with the power amplifier so that the power amplifier cannot be turned on initially if the MAX OUT is not in the RESET position.

3.2 PROGRAM SETUP

3.2.1 Turn system on or otherwise apply AC power to the line connection of the OSP-4. The STBY light should go on. Turn all CROSSOVER controls Max CW until stop is reached, turn MAX OUT CCW to RESET, and set MAX SPEED to 1K.

3.2.2 If the internal charge amplifier is used,set the accelerometer sensitivity in pC/g by means of the rear panel SENS RANGE switch and ten-turn SENS DIAL. Lock the SENS DIAL.

3.2.3 For the desired test program, switch the A-D SELECTORS for each segment as required, provide the proper F.S. RANGE for each segment by selecting the correct MULTIPLIERS, and set the significant digits for the test levels on the ten-turn LEVEL VERNIERS. Lock the dials and check all settings

If less than four segments are required, use the lowest numbered segments.

3.2.4 Switch the OSC MODE to MANUAL (This overrides the HOLD control), and rotate the COARSE and FINE tuning controls to set the crossover frequency between program segments 1 and 2. The indicator for segment 1 should be on. Rotate the CROSSOVER 1-2 control CCW until switching from segment 1 to segment 2 is indicated. Rotate the control back and forth until a very slight rotation causes switching. This establishes an accurate setting of the control.

3.2.5 Repeat Section 3.2.4 for each crossover frequency using CROSSOVER 2-3 next. Should less than four segments (and less than three crossovers) be required, the CW setting of the remaining CROSSOVER controls as in Section 3.2.1 will prevent switching to the unused program segments.

3.2.6 Push RESET DOWN and with a small screwdriver, set the LOWER LIMIT frequency for the test.

3.2.7 Push RESET UP and set the UPPER LIMIT frequency for the test.

3.2.8 Set the required SWEEP TIME for the test.

3.3 RUNNING THE AMPLITUDE-CONTROLLED TEST

3.3.1 Following the program setup in Section 3.2, with the servo mode in STBY, MAX OUT to RESET, and oscillator in RESET UP, push the servo mode ON. The COMPRESSION should go to 0 dB, but no signal is applied to the shaker because the MAX OUT is CCW. Turn the MAX OUT slowly CW. With the audible vibration signal, there should also be a slight upscale reading on the VIBRATION METER, indicating that there is a viable control signal entering the OSP-4. Should no vibration reading be registered, determine the source of difficulty or open connection before proceeding further.

3.3.2 After determining that a closed loop exists, return the servo to STBY, push the RESET UP/DOWN button to start the test at the required frequency. Then turn MAX OUT full CW, depress the ON button, and following the establishment of the test level in 2 seconds or less, depress SWEEP, thus starting the test.

3.3.3 As the frequency sweeps, watch the COMPRESSION METER to insure that adequate compression is obtained over the entire frequency range. Adjust MAX OUT slowly to provide about 5 dB compression at the frequency requiring minimum compression.

3.3.4 Should instability of the servo result at high frequencies due to the presence of extremely narrow or high Q peaks in the acceleration response of the shaker and test specimen, try successively lower positions of the MAX SPEED switch until the oscillation of the vibration envelope disappears.

The MAX SPEED switch may also be set on 3K to increase response speed so long as amplitude instability does not occur.

3.3.5 Following the required number of test sweeps, or for any other reason, the test may be terminated by pushing the STBY button. The vibration level decreases to zero, and the oscillator goes automatically to the HOLD mode.

3.3.6 Should any attempt be made to push an A-D selector, MULTIPLIER, RESET, MAN, LEVEL CAL, or OFF button, the servo automatically goes to STBY. Other instrument switches in the external interlock string have the same effect. To reestablish servo control, examine all switch settings carefully, and repeat Section 3.3.2.

3.4 MANUALLY CONTROLLED TEST

3.4.1 Establish the following settings:
MAX OUT to RESET
SERVO MODE to OFF
Turn all CROSSOVER controls CW until stop is reached.
A-D, MULTIPLIERS - as desired for function and F.S. RANGE for Segment 1
OSC MODE to MAN

3.4.2 Adjust the oscillator frequency with the COARSE and FINE controls as needed, and turn MAX OUT CW until desired vibration level is indicated on the VIBRATION METER.

3.4.3 Use the MAX OUT control to adjust the vibration level as frequency is varied.

3.4.4 The MULTIPLIERS and A-D selectors may be switched without interrupting the test because the VIBRATION METER merely monitors the vibration level. However, any attempt to change the SERVO MODE will cause the servo to go to STBY initially. However, holding the ON or LEVEL CAL buttons in will allow the servo to cycle to these modes after a delay of a second or two. Changing the OSC MODE to RESET UP or DOWN from MAN also causes the servo to go to STBY.

3.5 OPERATION WITH MODEL MAC-8 SIGNAL AVERAGER

3.5.1 Refer to Section 3.1.4 for connections.

3.5.2 The program setup follows the same procedure as in Section 3.2, except that the internal charge amplifier is not used. The MAX SPEED may have to be set lower than 1K to keep distortion components below acceptable limits due to the unusual nature of the control signal (See MAC-8 manual). Amplitude servo control of the average acceleration may be obtained only for accelerati segments of the program, since integration of the multiplexed control waveform is meaningless and produces spurious results.

3.5.3 The OSP-4 allows constant displacement segments to be automatically controlled from one selectable input of the MAC-8. Automatic switching to average control for constant acceleration segments is also obtained. See Section 3.4 and 3.5 in MAC-8 Manual.

3.5.4 MAC-8 Settings
CONTROL MODE to SINE PROG
BYPASS CHANNEL to desired control channel
for DISP control
ACTIVE CHANNELS - push in buttons for unused channels

3.5.5 Follow Section 3.3 for running the vibration test. The VIBRATION METER is a true full-wave average indicating device and therefore will indicate the average magnitude of the input accelerations to the MAC-8. The peak factor is at least 4:1.

4. CHECKOUT - CALIBRATION

Sections 4.1 through 4.14 constitute a complete but reasonably simple checkout procedure that can be adapted for periodic calibration purposes. Figure 4.1 shows the card and adjustment locations with the top cover removed from the OSP-4. DO NOT ATTEMPT ADJUSTMENT PROCEDURES UNLESS MEASUREMENTS ARE OUTSIDE INDICATED TOLERANCES. Factory setup was done using digital instruments.

4.1 Instruments Required

Oscilloscope	(CRO)	(HP1202B)
AC Voltmeter	(ACVM)	(Keithley 168 Autoranging DMM)
DC Voltmeter	(DCVM)	
Ratio Transformer	(RT)	(Singer RT-20R)
Universal Counter		(HP5325B)

All voltages measured with the ACVM should be viewed with the CRO.

4.2 SERVO MODE - Provide jumper between J2-1 and J2-2. Apply power to the line cord of the OSP-4. The STBY light should go on, as should the oscillator HOLD Reset down light, if RESET or MAN buttons are not depressed.

With MAX OUT CW, press LEVEL CAL., causing indicator to go on, and COMP meter to go 0-80 dB. Then press ON, and keep button depressed, causing STBY indicator to go on for 1-2 seconds and then causing ON indicator to go on. COMP meter goes below 80 dB, then to 0 dB. Press OFF button, causing STBY to go on.

With MAX OUT in RESET, pressing any button momentarily causes that mode to be established immediately. The OFF mode causes COMP meter reading of 0 dB.

4.3 OSCILLATOR MODE

4.3.1 SWEEP - Press SWEEP momentarily, causing UP or DOWN light to go on and frequency to change. Press REVERSE several times and check that sweep direction reverses.

4.3.2 HOLD - Press HOLD momentarily, causing sweep to stop and indicator to go on. Frequency should remain constant.

4.3.3 MAN - Monitor OSC OUT with ACVM and CRO. Press MAN with COARSE and FINE controls adjust frequency over three decade range. The ACVM should indicate 1.0 V rms $\pm$6% over the entire frequency range, and no visual distortion should be apparent. Refer to Sections 4.17 and 4.18 if output is not flat or if distortion is apparent.

4.3.4 RESET DOWN - Press RESET DOWN and check that frequency may be varied over three decade range with LOWER LIMIT control.

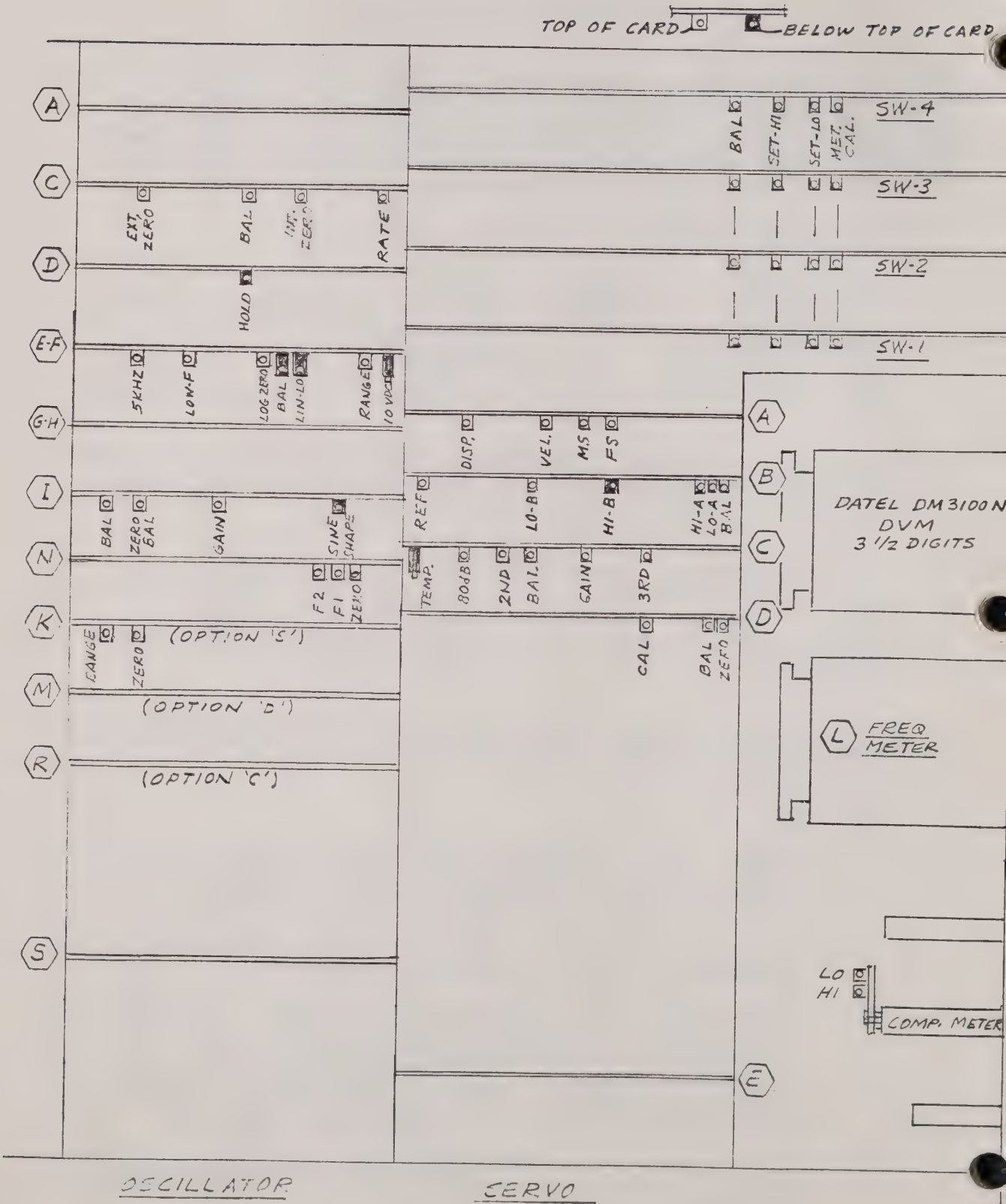


FIG. 4-1

MODEL OSP-4 CARD & ADJUSTMENT LOCATIONS

4.3.5 RESET UP - Turn RESET DOWN fully CCW. Then check that frequency may be varied over three decade range with UPPER LIMIT control. Note that the frequency counter has 1 Hz resolution.

4.4 SWEEP TIME - A stop watch or an electronic timer such as the HP Model 5325B Universal Counter can be used for measurement. The reversing pulse on D-OSC-8 can be used to start and stop the counter. Set:

LOWER LIMIT max. CCW (∿5 Hz)
UPPER LIMIT max. CW (∿5 kHz)
SWEEP TIME to 1.0 min

Press RESET DOWN, then SWEEP and measure time until DOWN light goes on. Then press RESET UP, the SWEEP and measure time until UP light goes on. Both sweep times should be 1 min ±1 second.

If a check on longer sweep times is desired, set the time and proceed as above. Tolerance is ±2%. Refer to Section 4.15 if tolerances are exceeded.

4.5 LIN FREQ OUTPUT - Monitor LIN FREQ output with a digital DCVM. Monitor frequency/period for accurate low frequency measurement with a universal counter if desired. The front-panel indicator is acceptable for frequencies above 100 Hz. Table 4.1 gives acceptable values of LIN FREQ Output vs frequency:

FREQ	LIN FREQ Output
5 Hz	10 mV DC ±2 mV
50 Hz	100 mV DC ±2 mV
500 Hz	1 V DC ±20 mV
5,000 Hz	10 V DC ±200 mV

TABLE 4.1
LIN FREQ output

For out-of-tolerance indication, consult Section 4.16.

4.6 LOG FREQ OUTPUT

4.6.1 Monitor LOG FREQ output with a digital DCVM. Monitor frequency/period if desired.

4.6.2 Table 4.2 gives acceptable values of LOG FREQ Output vs frequency:

FREQ	LOG FREQ OUTPUT
5	0 V DC ±4 mV
50	.400 V DC ±4 mV
500	.800 V DC ±4 mV
5000	1.200 V DC ±4 mV

TABLE 4.2
LOG FREQ output

4.6.3 If above readings do not fall within tolerances, set 1.200 V at LOG DC output with UPPER LIMIT in RESET UP. Adjust BAL on EF-OSC card to give 5000 Hz on frequency indicator.

4.6.4 Then set 0.600 V DC on LOG DC output with MAN and FINE and COARSE controls. Adjust RANGE for exactly 158 Hz.

4.6.5 Finally set 0.00 V DC on LOG DC output in RESET DN with LOWER LIMIT pot. Adjust LOG ZERO on EF-OSC card for 5.0 Hz.

4.6.6 Repeat adjustments on EF-OSC card in 4.6.3, 4.6.4, and 4.6.5 if necessary. Voltage at EF-8 should be 10.06 ±.04 V DC.

4.7 Maximum Output - AGC Amplifier

4.7.1 Monitor: COMP OUT with ACVM and CRO

4.7.2 Set: OSC MODE to MAN
SERVO MODE to OFF
MAX OUT to RESET, then to full CW

4.7.3 Adjust oscillator frequency to 1 kHz. COMP OUT should be 9.0 V rms with no visible clipping or distortion. Vary the frequency over the three-decade range. No more than 20% frequency response error should be evident with no visible distortion.

4.7.4 Change setting of ADJ MAX OUT if voltage is not within tolerances, or change setting of GAIN pot. on C-SERVO board (AGC Amplifier).

4.8 Acceleration Calibration - Vibration Meter

4.8.1 Provide connections and monitor as in 4.7.1. Make sure that vibration meter is at zero with no power on. Mechanical zero adjustment is on rear of meter.

4.8.2

Connect:	COMP OUT	to	10 mV/g IN
Set:	MAX OUT	to	Full CW
	MAX SPEED	to	3K dB/sec
	CROSSOVERS	for	active Segment 1
	A-D SELECTORS	to	ACC
	F.S. RANGES	to	10 (X10 MULT)
	LEVEL VERNIER	to	1.000 (10 turns)
	SERVO MODE	to	ON

4.8.3 The ACVM should read 100 mV pk (70.7 mV rms) ±1% and the VIBRATION METER should read 10.0 ±1%. If either reading is out of tolerance, adjust SET HI on SW1-SERVO for exactly 10.0 on the VIB. METER, and then adjust METER CAL for exactly 70.7 mV rms on the ACVM.

4.8.4 Adjust LEVEL VERNIER to 0.100 (1.0 turns). The ACVM should read 10 mV peak (7.07 mV rms) ±1%. If the reading is out of tolerance adjust SET LO on SW1-SERVO card. Repeat 4.8.3 and 4.8.4.

4.8.5 Set CROSSOVERS for active Segment 2, and repeat 4.8.3 and 4.8.4 for Segment #2.

Then repeat for active segments 3 and 4. If the VIBRATION METER indication is out of tolerance, refer to 4.19.

4.9 Displacement Calibration

4.9.1 Provide connections and monitor as in 4.7.1.

4.9.2 Provide same settings as in 4.8.2 except that A-D SELECTOR for active segment is pushed in for DISP.

4.9.3 The VIBRATION METER should read 10.0. At 100 Hz the ACVM monitoring COMP OUT should read .511 V pk (.361 V rms) ±2%. If the reading is out of tolerance, adj DISP. pot. on A-SERVO card (Charge Converter -DAG-Integrator), until ACVM reads correctly. At other frequencies and range switch settings correct readings are summarized in Table 4.3.

It is recommended that frequencies/periods be monitored with a universal counter capable of accuracies to 0.1%.

FREQ (Hz)	F.S. RANGE in p-p	VERNIER	COMP OUT V rms
5	10.0	10	.0903
10	10.0	10	.361
20	1.0	10	.144
50	.1	10	.0903
100	.1	10	.361
500	.01	10	.903

Table 4.3 Displacement Calibration

Should the readings for COMP OUT be inaccurate by more than ±3%, consult Section 4.20.5.

4.10 Crossover Switching - At a frequency of approximately 1000 Hz (MAN mode) adjust each crossover control to provide switching from one segment to another. Then vary the frequency back and forth slowly with the FINE control and note the switching frequencies. The hysteresis or overlap should be less than 25 Hz (2.5%). Should the switching hysteresis be excessive, consult the factory.

4.11 Compression Speed

4.11.1 Provide connections and monitor as in 4.7.1.

4.11.2 Provide settings as in 4.8.2 except set:

LEVEL VERNIER (Seg 1) to .800 (8 turns)
LEVEL VERNIER (Seg 2) to .600 (6 turns)

4.11.3 At a frequency of 5 Hz, adjust CROSSOVER 1-2 so that rotating it back and forth slightly causes switching from Segment 1 to Segment 2. View the envelope of the COMP OUT signal with the CRO, using a slow sweep (.5 sec/cm). When the switching of control takes place, the trace on the CRO should appear as in Fig.4.2.

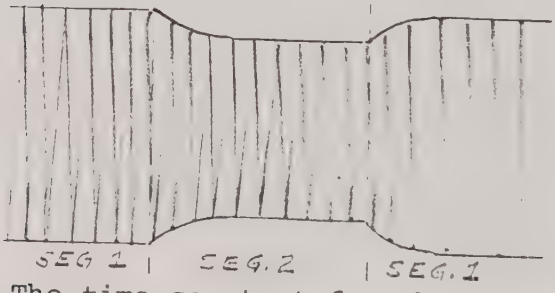


FIG. 4.2
ENVELOPE OF
CONTROL SIGNAL

4.11.4 The time constant for the signal envelope for the oscilloscope trace viewed in 4.11.3 should be 1.0 ±0.5 sec. This corresponds to a compression speed of 10 dB/sec. The time constant is the time the envelope takes to make approximately 2/3 the change between the initial and final values.

4.11.5 Change the frequency to 5 kHz, and adjust CROSSOVER 1-2 to provide switching as in 4.11.3. Use a faster sweep on the CRO (2 msec/cm). The measured time constant for the envelope when switching takes place should be 3.0 ±1.5 msec.This corresponds to a compression speed of 3000 dB/sec.

4.11.6 Should the measurement in 4.11.4 and 4.11.5 be out of tolerance, consult Section 4.20.4.

4.12 COMPRESSION Meter

4.12.1 With connections as in 4.7.1 and settings as in 4.8.2, except that LEVEL VERNIER for Segment 1 is adjusted to .127 (1.27 turns) to give 1.27 g peak (9 mV rms), COMPRESSION meter should read 60 dB.

4.12.2 Rotate MAX OUT CCW to RESET, and COMP meter should read 0 dB.

4.12.3 If meter requires readjustment, for condition in 4.12.2 adj. HI pot. on the small card bolted to the meter ter-

minals. For 60 dB reading, in 4.12.1, adjust LO pot. Repeat until readings are accurate.

4.13 Zero Compression Error

4.13.1 With connections as in 4.7.1 and settings as in 4.8.2 except that all MULTIPLIER buttons are OUT (X1), LEVEL VERNIER for Segment 1 is adjusted to 1.00 (10 turns) to give a VIBRATION METER READING of 1.00 g (full scale) and a COMPRESSION reading of approximately 63 dB.

4.13.2 Reduce COMP. reading to approx. 5 dB by turning MAX. OUT CCW slowly. There should be no visible change in the reading of the VIBRATION METER, indicating zero static compression error.

4.14 Charge Amplifier - Sensitivity Normalizer Calibration (A-SERVO)

4.14.1 Apply .100 V rms at 100 Hz in series with a 1000pF ½% capacitor to the CHG IN. Monitor 10 mV/g OUT with an ACVM and CRO. It is preferable to provide a shielding box around the capacitor. The arrangement provides an input of 100 pC to the charge converter.

4.14.2 Table 4.4 gives the measured voltage at 10 mV/g OUT for several conditions. Appropriate adjustments on the A-SERVO card are also given.

-REAR PANEL-

SENS pC/g	RANGE	10 mV/g OUT ±1%	ADJUST
10	1-10	.100 V rms	FULL SENS (FS)
1	1-10	1.00 V	MIN SENS (MS)
100	10-100	.0100 V	Change 9000 pF
10	10-100	.100 V	Change 9000 pF

TABLE 4.4 CHARGE AMPLIFIER - DAG CALIBRATION

4.14.3 VEL CAL - This adjustment changes the gain of the vel. int and normally does not have to be readjusted, since velocity is not controlled in the OSP-4.

4.14.4 DISP CAL - This adjustment changes the gain of the displacement integrator. See procedure in 4.9.

THE FOLLOWING SECTIONS DESCRIBE PROCEDURES THAT ARE NOT NORMALLY PART OF ROUTINE CHECKOUT AND CALIBRATION PROCEDURES. DO NOT ATTEMPT THESE IF THERE IS NO INDICATION OF UNSATISFACTORY PERFORMANCE. Those potentiometer adjustments on all cards not included in Section 4.1 through 4.14 are discussed in the following sections.

4.15 Sweep Circuit (Cards C-OSC, D-OSC)

4.15.1 Sweep HOLD - If drift of oscillator frequency in the HOLD mode is greater than 2.5 Hz/min or 2.5%/min below 100 Hz, adjust HOLD pot.on D-OSC card for minimum drift at a frequency of 1000 Hz.

4.15.2 INT. ZERO, EXT. ZERO, BAL (C-OSC) - These controls affect the accuracy of long sweep times (Section 4.4) and should not be changed unless the sweep times of 10 min and above are inaccurate.

With LOWER LIMIT and UPPER LIMIT CCW, short pins C-OSC-8 and 9 to reference 11. With SWEEP TIME set at 10.0 min. adjust INT. ZERO to produce 0 V DC ±1 mV at C-OSC-6. Then adjust EXT. ZERO to produce 0 V DC ±1 mV at C-OSC-TP1. Finally adjust BAL to produce 0V DC ±1 mV at C-OSC-TP2.

4.15.3 RATE (C-OSC) - Set SWEEP TIME at 1.0 min. for 5 Hz to 5 kHz sweep. Use RATE (RT) adjustment to get upward sweep time at 1.0 min ±1 sec. Downward sweep should be within this accuracy also. If not, the nominal 220k resistor marked ** near Z2 must be changed.

4.15.4 Set SWEEP TIME at 10.0 minutes or longer if desired for 5 Hz - 5 kHz sweep. If upward sweep time is not within 2% tolerance, turning EXT. ZERO pot one turn CW increases the upward and downward sweep time approximately 10 sec. Following this, the downward sweep time may be adjusted by adjusting the BAL pot. Turning the BAL pot one turn CW increases the downward sweep time 10 sec.

4.16 High Frequency Generator (Card EF-OSC)

4.16.1 Monitor OSC OUT with CRO and frequency counter. Monitor DC voltage at LIN. FREQ with a DVM. Select MAN mode for oscillator.

4.16.2 Adjust voltage at LIN FREQ to 10.00 ±.01 V DC with FINE and COARSE controls. Frequency meter and external counter should read 5000 ±5 Hz. Adjust 5 kHz on EF card if necessary.

4.16.3 Adjust voltage at LIN FREQ to 10.0 ±0.5 mV DC. Frequency indication should be Voltage/2 ±.1 Hz (approx. 5 Hz). Adjust LOW F if necessary.

4.16.4 Repeat 4.16.2 and 4.16.3 if adjustments in 4.16.2 and 4.16.3 were made.

4.17 Tracking Low-Pass (N-OSC) - Should the oscillator voltage not remain constant in amplitude over the three-decade range in Section 4.3.4, or if 32nd harmonic stain-step distortion is noticed at OSC. OUT., the adjustment of N-OSC should be checked. If replacement of the electrically-variable-resistors (EVR) is indicated, it is recommended to purchase a matched set from the factory.

4.17.1 Remove the Sine Generator Card (I-OSC) and connect an external sine oscillator to N-OSC-17, the input terminal. Monitor the voltage at N-OSC-TP1 with an ACVM and CRO. Adjust the external oscillator for 1V rms.

4.17.2 FLATNESS - F1 - Set indicated frequency of OSC-1 at 100 Hz. Sweep the external oscillator and note response at TP1. For an external frequency of 150 Hz adjust F1 for 1V rms (flat response) at JP-1.

4.17.3 ZERO - Set indicated frequency of OSC-1 at 10 Hz, and external oscillator at 30 Hz. Adjust ZERO pot. for 3 dB attenuation (.707 V rms) at TP1.

4.17.4 FLATNESS - F2 - Use same settings as in 4.16.2. Monitor N-OSC-18 with the ACVM and CRO. Sweep external oscillator to note response and high frequency drop off. For an external frequency of 125 Hz adjust F2 for a flat response (1V rms).

4.17.5 Remove external generator and replace I-OSC card. Sweep OSC-1 frequency over the three decade range. There should be no visible stair-step distortion (32f) and the voltage at N-18 (OSC. OUT) should be constant $\pm$6%.

4.18 Sine Generator (I-OSC) - The adjustments on the I-OSC card affect the second and third harmonic distortion and the amplitude of the voltage at OSC OUT No distortion adjustments should be attempted unless a distortion analyzer is used (HP Model 331A or equivalent). The order of the harmonic distortion on the analyzer indicates the required adjustment.

4.18.1 BAL - This potentiometer adjusts the relative magnitudes of the positive and negative halves of the sinusoid. Improper adjustment causes second harmonic distortion (adjust at 300 Hz).

4.18.2 SINE SHAPE - This adjustment affects third harmonic distortion at lower frequencies. Adjust at 300 Hz.

4.18.3 ZERO BAL - This adjustment insures that the zero-level stairsteps in both directions are the same. Improper adjustment affects second harmonic distortion slightly, but not nearly to the same degree as in 4.18.1.

4.18.4 High Frequency Distortion. Second-harmonic distortion at high frequencies (above 1 kHz) indicates delay unbalance in the signal inverter. Capacitor ** (Fig. 7.20) is adjusted at the factory to minimize distortion.

4.18.5 GAIN (RA) - If voltage at OSC OUT is not 1 V rms ±5% at 1000 Hz, adjust RA.

4.19 Switching Amplifiers (SW 1 through SW 4 - SERVO)

4.19.1 METER CAL - The factory adjustment follows:

Apply .050 V rms, 100 Hz to 10 mV/g IN.
Monitor SW (1, 2, 3, 4) - SERVO-13 (meter Bus).
Set ACC/DISP to ACC; MULTIPLIER(S) to X10.

Adjust METER CAL for each segment so that monitored voltage is exactly .050 V rms. This assures that the meter indication will be the same for each segment on the 10 g (.1 in.) range.

4.19.2 BALANCE - For a setting of 1.0 turns on each LEVEL VERNIER and with MULTIPLIERS to 100X, monitor the DC voltage at TP1 for SW1. Adjust BAL for 0 ±20 mV DC at TP1. Repeat for SW2, SW3 and SW4.

4.19.3 SET HI - This adjustment provides the proper gain for the 10-turn setting of the level vernier. For the input voltage and settings in 4.19.1, monitor Pin 14 (Signal Bus), and set all LEVEL VERNIERS at 10.00 turns. Adjust SET HI for all segments so that the measured voltage at Pin 14 is exactly 0.40 V rms.

4.19.4 SET LO - This adjustment provides the proper gain for the one-turn setting of the LEVEL VERNIER. Following 4.19.3, reduce the input voltage to 5.00 mV rms and set all LEVEL VERNIERS at 1.00 turns. Adjust SET LO for all segments so that the measured voltage at Pin 14 is exactly 0.40 V rms.

4.20 AGC Control (B-SERVO)

The adjustment of the tracking high-pass filter section is necessary only if the tolerances for the readings in Table 4.3 cannot be maintained over the frequency range for the displacement calibration in 4.9. The adjustment of the tracking resistance circuit that controls compressor speed is necessary only if gross errors are noticed in compression speed (Section 4.11).

4.20.1 AGC. REF. - This adjustment changes the calibration of the LEVEL VERNIERS, and should only be readjusted following the procedure in 4.19..

Connect	COMP OUT	to 10 mV/g IN
Set	INPUT SELECTOR	to 10 mV/g IN
Monitor	COMP OUT	with ACVM and CRO
Set all	MULTIPLIERS	to X10
all	LEVEL VERNIERS	to 1.000 (10 turns)
	MAX OUT	to 10V (CW)
	FREQ	to 100 Hz
	SERVO MODE	to ON

With Segment 1 active, measure the voltage at COMP OUT and adjust AGC REF so that voltage is exactly 70.7 mV rms. The measured voltage for Segments 2, 3, and 4 being active should also be 70.7 mV rms due to the adjustments in 4.19.

4.20.2 METER GAIN (D-SERVO) - Adjust this control so that vibration meter reads 1.000, for the conditions in 4.20.1.

4.20.3 As a check, with MAX. OUT in RESET position (zero signal to 10 mV/g IN), the voltage measured at TP1 should be about -2.0 V DC.

4.20.4 HI-F-B, LO-F-B - These potentiometers provide adjustment for the compressor speed at 5000 Hz and 5 Hz respectively. Remove the AGC Amplifier Card (C-SERVO). Set MAX SPEED at 3K, and monitor resistance across TP2 and TP3 with a multimeter.
Make sure the SERVO is in the ON or LEVEL CAL mode.

With the frequency at 5 kHz, adjust HI-F-B for a resistance of 3.3K $\pm$10%. Change the frequency to 5 Hz, and adjust LO-F-B for a resistance of 1.0 M $\pm$20%. Sweep the frequency back and forth and repeat these measurements. Replace the C-SERVO card.

4.20.5 HI-F-A, LO-F-A - These potentiometers provide adjustment for the tracking high-pass filter at 15 Hz and 1500 Hz respectively. Remove the Charge Amplifier card (A-SERVO). Apply 1.0 V rms to B-SERVO-6, and monitor the output at B-SERVO-7 with an ACVM and CRO.

Set the OSP-4 frequency to 1500 Hz and the external oscillator to 500 Hz. Adjust HI-F-A for approximately .7-.8V rms output. Sweep the external oscillator frequency and make certain that the output voltage at 1500 Hz is 1.00 V ±3%.

Then set the OSP-4 frequency to 15 Hz and the external oscillator to 5 Hz. Adjust LO-F-A for approximately .7-.8V rms output. Sweep the external oscillator frequency to make certain that the output voltage at 15 Hz is 1.00 V rms ±3%. Repeat the operation at 1500 Hz and 15 Hz.

Then for equal frequencies of the OSP-4 and the external oscillator at 5, 15, 50, 150, and 500 Hz check that the output voltages do not vary from a median value (1.00 V ±3%) by more than ±1%. If the above tolerances cannot be met, the EVRS (V1, V2, and V3) are probably not matched well enough. Consult factory. Replace A-SERVO card.

4.21 AGC Amplifier (C-SERVO)

4.21.1 3RD, 2ND - These adjustments control the third harmonic and second harmonic distortion components from the AGC amplifier. They also affect the maximum output and balance, respectively, so they must be adjusted first. A distortion analyzer (HP331A or equivalent) must be used for the adjustment. Turn ADJ MAX OUT on rear panel max CW and back off 1/2 turn. With the same connections and settings in 4.20.1, except that the MULTIPLIER on the active segment is X100, and the COMP. OUT. is monitored by the distortion analyzer, adjust 3RD and 2ND for minimum harmonic distortion (less than 0.2% typically).

4.21.2 GAIN - Put SERVO in OFF mode and turn MAX OUT max. CW. Adjust GAIN for 10 V rms at COMP. OUT jack.

4.21.3 80 dB. Put SERVO in STBY mode and MAX OUT max CW. Monitor voltage at COMP OUT with CRO. Adjust 80 dB until signal component voltage <u>just</u> disappears and only wideband noise remains.

4.21.4 BALANCE - Provide the following connections and settings:

Connect		COMP OUT to 10 mV/g IN
Set	INPUT SELECTOR	to 10 mV/g IN
Monitor		COMP OUT with ACVM and CRO
Set	MULTIPLIER	to X100 - Segment 1
	MULTIPLIER	to X10 - Segment 2
	LEVEL VERNIERS	to 1.000 (Segs. 1 & 2)
	FREQUENCY	to 5 kHz
	SERVO MODE	to ON
	MAX SPEED	to 1 K dB/sec
	MAX OUT	to 10 V (max CW)

As in Section 4.11 rotate CROSSOVER 1-2 back and forth so that switching from Segment 1 to Segment 2 and back again occurs. View the envelope of COMP OUT with the CRO using a relatively slow sweep. A displacement of the smaller envelope from the center of the trace just following switching requires adjustment of the BAL control. See Fig. 4.3

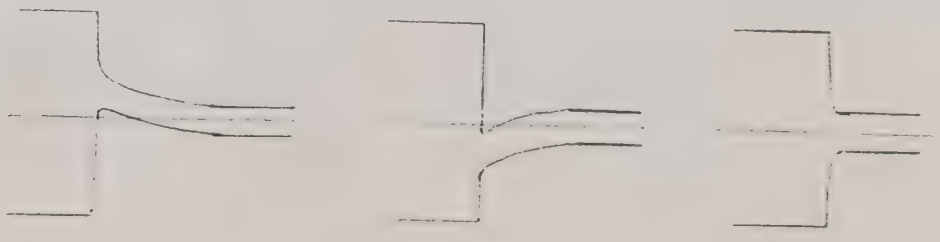


Fig. 4.3 Adjustment of BAL Control

5. CIRCUIT DESCRIPTION

The signal schematic for the oscillator section is found in Fig. 7.2 and that for the servo section in Fig. 7.1. The detailed circuitry and component layouts for individual cards are given in Figures 7.5 through 7.43. The interlock and power supply circuits are in Figs. 7.4 and 7.3.

Oscillator section circuit description is found in Sections 5.1 through 5.10.

5.1 The SWEEP LIGHT CONTROL card (A-OSC) contains the HOLD mode flip-flop, and drivers for the UP, DOWN, and HOLD lights.

5.2 The SWEEP SPEED CONTROL card (C-OSC) generates a symmetrical square-wave drive current. The magnitude of the drive current from Pin 17 is proportional not only to the difference between the UPPER and LOWER LIMIT (voltage between 9 and 8), but also the inverse of the selected SWEEP TIME. The direction of the drive current is reversed by the logic signal to Pin 14.

5.3 The SWEEP GENERATOR card (D-OSC) accepts the drive current from C-OSC and integrates it to produce a symmetrical triangular wave voltage at 15. Because of the properties of the drive current, the SWEEP TIME is independent of the UPPER and LOWER LIMITS. The UPPER and LOWER LIMIT comparators are used to reverse the sweep direction, as does the logic signal from the REVERSE flip-flop.

5.4 The LOG CONVERTER card (E-OSC) actually contains an anti-log circuit which produces the logarithmic sweep at 20 from the triangular input at 8.

5.5 The HIGH-FREQUENCY OSC card (F-OSC) is a voltage-controlled oscillator with a frequency proportional to the sweep voltage from E-OSC. The input voltage is converted to a symmetrical square wave current, which is fed to an integrator. The magnitude of the square wave is proportional to the input voltage. The output of the integrator is a symmetrical triangle. The switching of the integrator input current is accomplished by two comparators providing fixed upper and lower limits for the triangular output. The flip-flop generates the logic signal to switch the integrator current. A positive pulse is generated at each reversal at 7. The pulse frequency is 32 times the frequency at the OSC OUT jack.

5.6 The FREQUENCY DIVIDER card (H-OSC) receives the 32f pulse train from F-OSC and provides a 2f and 1f square wave for the I-OSC card. The 32f pulse train is also divided into an irregularly spaced 10f pulse train which is used to provide the frequency display.

5.7 The COUNTER CONTROL card (G-OSC) provides timing control circuitry for the DISPLAY COUNTER. The power frequency signal is divided to provide three pulses every 0.1 sec. The first pulse strobes the content of the counter into the display buffer, the second pulse resets the counter and the third pulse interrupts the input to the counter during the first two pulse periods.

5.8 The DISPLAY COUNTER card (L-OSC) is a four-decade counter and four-digit display. As explained in 5.7, the frequency measurement is updated every 0.1 second.

5.9 The SINE GENERATOR card (I-OSC) contains an eight-bit reversible shift register (Z1, Z3), eight current switches (Z2, Z4), and a signal inverter (Z5, Z6).

The shift register shifts at the 32f rate and reversing is provided by the 2f signal. Zeroes are shifted in from the low side (1) and ones from the high side of the shift register (8). Each current switch feeds a current into the junction of an op amp for a zero input from the shift register. Thus as zeroes are shifted into the shift register, the currents from each current switch are successively added, and produce one quarter of a stepped sine wave at the op amp output. The 2f signal causes the zeroes to be shifted out and the second quarter of the sine wave is produced.

The 1f square wave causes signal inversion over the next half cycle, thus producing the final half of the complete stepped sine wave appearing at 19 and 20.

The harmonic distortion is approximately 4% with mostly 31st and 33rd harmonics.

5.10 The TRACKING LO-PASS card (N-OSC) filters these high order harmonics. Two separate two-pole sections are cascaded. The variable cutoff frequency is produced by using matched electrically variable resistors (EVR) in conventional low-pass active filter circuits. The EVR resistance is controlled to be inversely proportional to frequency.

Servo-programmer circuit description is found in Sections 5.11 through 5.16.

5.11 The CHARGE CONVERTER card (A-SERVO) contains the charge converter circuit (Z1, Z2), the DIAL-A-GAIN sensitivity normalizer (Z3), a three-pole Butterworth low-pass filter (Z3), the velocity integrator (Z4, Z5) and the displacement integrator (Z6, Z7). The acceleration signal (pin 10) is used for control when an external signal conditioner is not used. The acceleration signal (13) and displacement signal (19) are bussed to the SWITCHING AMPLIFIER cards for control selection and monitoring purposes.

5.12 The SWITCHING AMPLIFIER cards (SW-1 through SW-4) contain the LEVEL MULTIPLIER (Range Selection) switches, the A-D selector switches, and two CMOS switches for selecting the meter input signal and the control signal.

The LOG FREQ. signal input is compared to the voltage produced by the CROSSOVER CONTROL (SW-1, SW-2, SW-3). The comparator (Z6) output is fed to TTL logic (Z10) so that the meter and control signal outputs from only one SW card are selected.

A logic 0/1 is also provided on the pin 5 bus when the active SWITCHING AMPLIFIER card is controlling acceleration/displacement. This output is necessary for use with the Models MAC-8 and ACS-6.

5.13 The AGC CONTROL card (B-SERVO) contains a two-pole tracking high-pass filter, and circuitry necessary for controlling the AGC AMPLIFIER. The tracking high-pass filter is placed between the velocity and displacement integrators (A-SERVO). The matched EVR's are controlled by the LIN FREQ so that the 3 dB cutoff frequency is approximately 1/3 the operating frequency, and the response is flat at the operating frequency. In this fashion low-frequency noise from the integrators is greatly reduced and control to very low displacements at high frequencies is possible without saturation or instability problems.

The A-D control signal from the SWITCHING AMPLIFIERS is full-wave rectified and prefiltered. Matched EVR's are used in the prefilter circuit and in the circuit determining compressor speed. The EVR controlling compression speed converts voltage to a drive current from I7. The prefilter circuit prevents signal distortion under closed-loop conditions. The resistance of the EVR is controlled as a continuous function of frequency. The relation between compression speed S and EVR resistance is approximately:

$$S = 10^7/R \qquad \text{dB/sec}$$

The maximum value of S at 5 kHz is determined by the setting of the MAX SPEED switch.

CMOS switches are also controlled by logic signals from the MODE CONTROL card to cause the control voltage to the second EVR to be replaced by +10 V or -10 V to yield the proper drive currents at I7 for the STBY and OFF modes respectively.

5.14 The AGC AMPLIFIER card (C-SERVO) contains an integrator Z6 which accepts the drive current from the AGC control card. The integrator output voltage controls the gain of the AGC amplifier (Z5, Z4), so that the gain in dB is a linear function of the integrator output voltage.

The amplifier (Z1, Z2, Z3) accepting the oscillator output signal predistorts the AC input to the AGC amplifier so that the output from the differential amplifier Z7 has extremely low distortion.

CMOS switches Z9 and Z11 route the AGC output to the power amplifier or back to the control input (CAL mode), depending on the state of the MODE CONTROL.

5.15 The METER AMPLIFIER card (D-SERVO) contains a precision full-wave rectifier, and a three-pole low-pass filter for providing a combination of low ripple and minimum rise time for the DC signal driving the VIBRATION METER.

5.16 The MODE CONTROL card (E-SERVO) contains a logic network and four R-S flip-flops to provide pushbutton control of the four servo modes, and the logic signals necessary to control the CMOS switches on other cards and the mode indicator lamps.

6. MAINTENANCE-SERVICING

6.1 Circuit Diagrams

The circuit diagrams and component layouts found in Section 7 should be used with signal tracing techniques to pinpoint any problems. The checkout and calibration procedures in Section 4 and the description of circuit operation in Section 5 are also invaluable aids for determining location of problems.

6.2 Access for Servicing

Removing the top cover exposes all adjustment potentiometers and printed circuit cards. All cards may be removed from the top by pulling them out of the connectors except for the SW-SERVO cards, the L-OSC card, and the small card on the rear of the COMP. meter. An extender card is included inside the chassis.

If it is desired to remove any of the SW-SERVO cards, first remove the knobs from the CROSSOVER controls. Then remove the five flat-head screws holding the front panel to the chassis. Pull the front panel slightly forward to clear the pushbuttons of the SW-SERVO cards and swing it down, using the wire harnesses as hinges. The SW-SERVO cards may then be removed.

In replacing the front panel, make sure all SW cards are completely seated in the connectors. Also be sure that the LED indicators are guided inside the lenses mounted on the front panel.

Removal of the bottom cover exposes all connections to the printed circuit cards.

ALL PRINTED CIRCUIT CARDS SHOULD BE REMOVED AND REPLACED WITH THE POWER OFF.

6.3 LED Replacement

Replacement of the light-emitting diodes on the SW cards may be done by simply resoldering a new LED to the PC card and shaping the leads properly.

A front-panel-mounted LED should be replaced by unsoldering the connecting wires, and pushing it out from the rear. Do not use any prying tools from the front, as these may scratch the panel. The new LED may be inserted by pushing it in from the front using a blunt tool on the lens of the LED.

6.4 Power Supply Voltages

If trouble is suspected, the voltages associated with the power supplies should be measured first. The power supply voltages are found in the table below.

CARDS	PIN	VOLTAGES (VDC)	MAX RIPPLE
ALL OSC CARDS	1 TO 11	+15.5 V ± 0.5 V	50 mV pp
ALL OSC CARDS	22 to 11	-15.5 V ± 0.5 V	10 mv pp
ALL OSC CARDS	5 to 11	+ 5.0 V ± 0.2 V	50 mV pp
E-OSC, F-OSC	8 to 11	+10.06V ± .01 V	10 mV pp
ALL SERVO CARDS	1 to 11	+15.5 V ± .2 V	10 mV pp
ALL SERVO CARDS	2 to 11	-15.5 V ± .2 V	10 mV pp
ALL SERVO CARDS	22 to 12	+ 5.0 V ± 0.2 V	50 mV pp

TABLE 6.4 Power Supply Voltages

6.5 Component Replacement

Component replacement on a printed circuit card should be a rare occurrence, but the following instructions should be followed to prevent damage to the printed circuit.

Most integrated circuits are socket-mounted, and may be replaced easily. Should a CMOS switch (AD7513) require replacement, it is important that the handler be physically grounded to prevent static charges from damaging the unit.

Should a permanently mounted part require remplacement, remove the excess solder at the points of insertion with a soldering iron and a desoldering wick (Dri-wick-American Electrical Heater Co.). On a single-sided board, the component can usually be lifted out with long-nose pliers. On a double-sided board with plated-true holes, however, it is necessary to heat each insertion point while pulling on the lead with pliers. Take care not to delaminate the printed circuit conductors.

There are also specifically-shaped tools available with soldering irons for removing multi-pin devices from two-sided boards.

6.6 Component List

Listed below is ordering information for integrated circuits, semiconductors, and other critical components used in the Model OSP-4. Other resistors and capacitors are widely available from many sources.

PART DESIGNATION	MANUFACTURER	DESCRIPTION
1N5394	Westinghouse	Si Power Rectifier
1N914A	Fairchild	Si Diode
1N100	Sylvania	Ge Diode
2N4919	Motorola	PNP Power
2N4922	Motorola	NPN Power
2N4403	Motorola	NPN
MC7805CP	Motorola	5V Regulator
µA723	Fairchild	Regulator
1N4735	Motorola	6.2 V Zener Diode
lN100	Motorola	Diode
7400N	T1, NS, Motorola	Quad 2 input NAND gate
7402N	"	Quad 2 input NOR gate
7404N	"	Hex inverter
7405N	"	Hex inverter
7406N	"	Hex inverter
7410N	"	Triple 3 input NAND gate
7411N	"	Triple 3 input AND gate
7420N	"	Dual 4 input NAND gate
7430N	"	8 Input NAND gate
7437N	"	Quad 2 input NAND gate
7474N	"	Dual D Flip Flop
7486N	"	Quad 2 input Excl or gate
7490N	"	Decade Counter
7492N	"	Divide-by-12 Counter
7495N	"	4 bit shift register
µA726	Fairchild	Temp. Cont. Dual NPN
µA747	Fairchild	Dual Op. Amp.
µA710	Fairchild	Comparator
LM30IAN	National Semi	OP. AMP.
LM324N	National Semi	Quad Op. Amp.
LM339N	National Semi	Quad Comparator
AD540J	Analog Devices	FET Op. Amp.
NE531V	Segnetics	High Slew Rate Op. Amp.
MC1458CP1	Motorola	Dual Op. Amp.
AD842	Analog Devices	Dual FET
ICL8019C	Intersil	Quad Current Switch
MC4050	Motorola	Counter-Latch-Decoder
5082-7730	Hewlett Packard	Seven-Segment Indicator
CAG30	Crystalonics	FET Switch
AD7513	Analog Devices	Dual CMOS Switch
DG200BA	Siliconix	Dual CMOS Switch
VTL2C2	Vac-Tec	Electronically Variable Resistors (matches sets)
Helitrim 89WR (Various Values)	Beckman	P.C. Potentiometers

7. SCHEMATICS - LAYOUTS

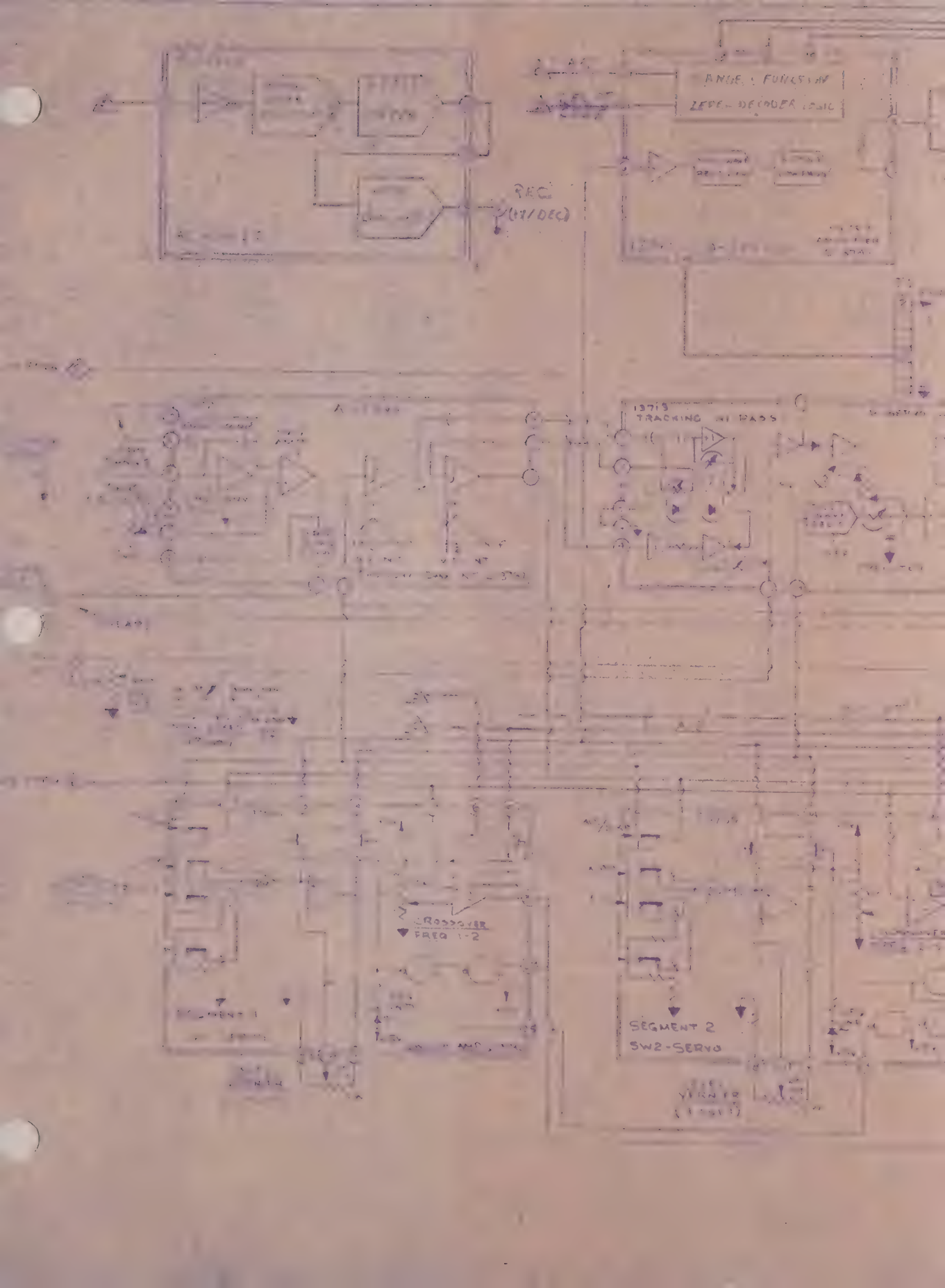
S.N. 416

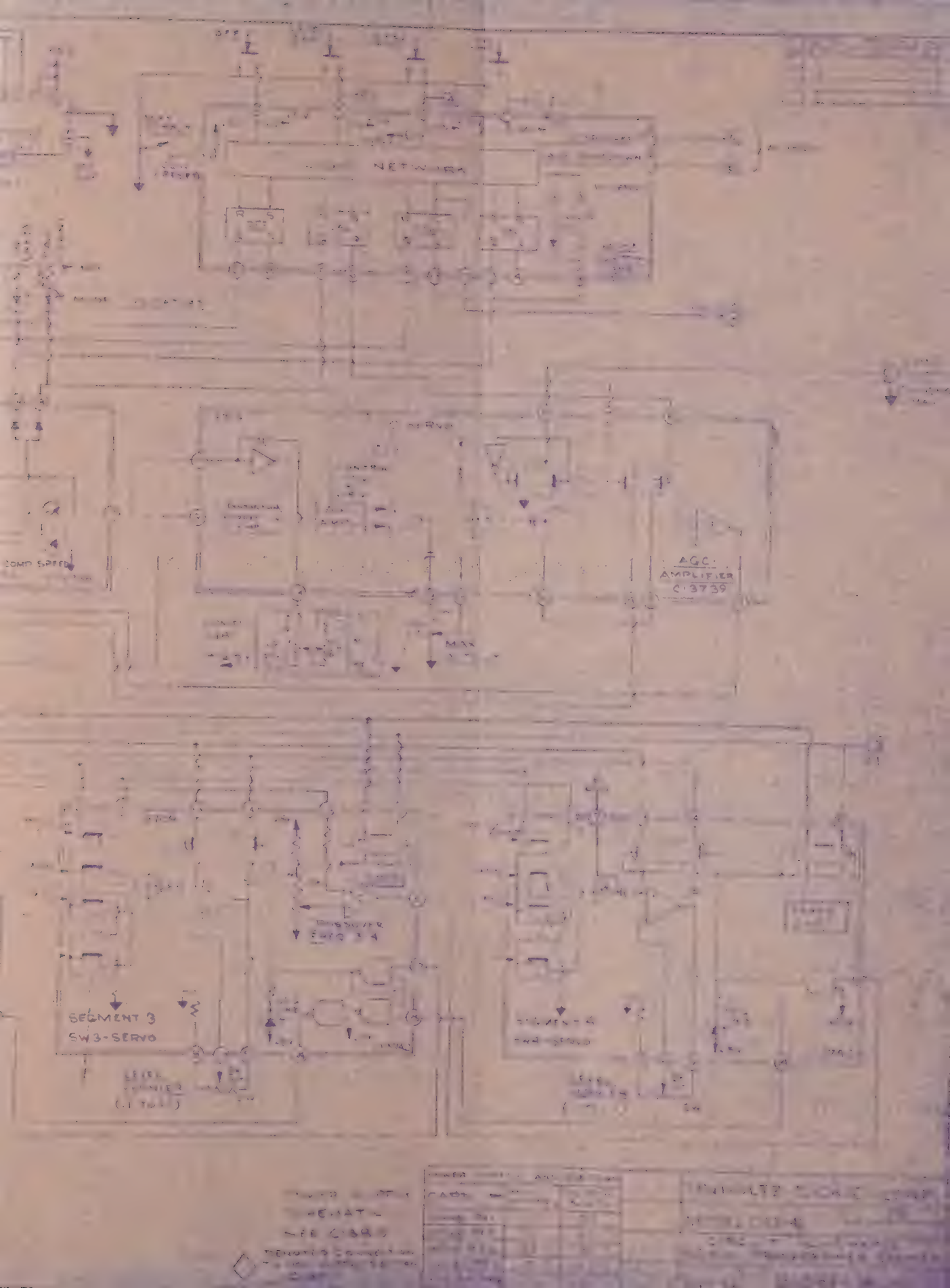
Fig.	Title	Dwg. No.	Rev.
7.1	Circuit - Servo Programmer	D13866	A
7.2	Circuit - Oscillator	D13846	NC
7.3	Circuit - Power Supply	C13819	NC
7.4	Circuit - Interlocks	A13847	NC
7.5	Circuit - Sweep Light Control-A-OSC	B9295	B
7.6	Layout - " " " -A-OSC	A9297	C
7.7	Circuit - Sweep Speed Control-C-OSC	B9311	C
7.8	Layout - " " " -C-OSC	A9298	B
7.9	Circuit - Sweep Generator -D-OSC	B9296	F
7.10	Layout - " " -D-OSC	A9299	G
7.11	Circuit - Log Converter -E-OSC	B9289	B
7.12	Layout - " " -E-OSC	A9290	C
7.13	Circuit - High Freq.Generator -F-OSC	B9274	D
7.14	Layout - " " " -F-OSC	A9275	E
7.15	Circuit - Counter Control -G-OSC	B9234	NC
7.16	Layout - " " -G-OSC	A9261	B
7.17	Circuit - Freq. Divider -H-OSC	B9235	B
7.18	Layout - " " -H-OSC	A9262	A
7.19	Circuit - Sine Generator -I-OSC	B9284	NC
7.20	Layout - " " -I-OSC	A9286	A
7.21	Circuit - Tracking Low-Pass -N-OSC	B9321	B
7.22	Layout - " " " -N-OSC	A9322	C
7.23	Circuit - Sweep Sync (Opt.) -K-OSC	B9269	C
7.24	Layout - " " " -K-OSC	A9265	A
7.25	Circuit - Display Counter -L-OSC	B13803	NC
7.26	Layout - " " -L-OSC	C13802	NC
7.27	Circuit - OSC Mode Control -S-OSC	B9371	NC
7.28	Layout - " " " -S-OSC	B9370	NC
7.29	Circuit - Chg. Conv.-DAG-Int -A-SERVO	C13737	A
7.30	Layout - " " " " -A-SERVO	B13722	B
7.31	Circuit - AGC Control -B-SERVO	C13738	E
7.32	Layout - " " -B-SERVO	D13714	C
7.33	Circuit - AGC Amplifier -C-SERVO	C13739	D
7.34	Layout - " " -C-SERVO	D13720	D

7. SCHEMATICS - LAYOUTS

S.N. 416

Fig.	Title		Dwg. No.	Rev.
7.35	Circuit - Meter Control	-D-SERVO	C13741	D
7.36	Layout - " "	-D-SERVO	B13718	D
7.37	Circuit - Mode Control	-E-SERVO	C13740	A
7.38	Layout - " "	-E-SERVO	B13716	B
7.39	Circuit - Switching Ampl.	-SW-SERVO	C13742	E
7.40	Layout - " "	-SW1-SERVO	C13734	NC
7.41	Layout - " "	SW2,SW3-SERVO	C13732	NC
7.42	Layout - " "	SW4-SERVO	C13733	NC
7.43	Layout - Servo Power Supply	PS-SERVO	B13724	NC
7.44	Layout - Osc. Power Supply	PS-OSC-1	B13821	A
7.45	Layout - Osc. Power Supply	PS-OSC-2	B13822	NC
7.46	Circuit - AC-LOG DC CONV.	F-SERVO	B13743	NC
7.47	Layout - AC-LOG DC CARD	F-SERVO	B13728	NC


RANGE + FUNCTION
ZERO - DECODER LOGIC
REC
(UP/DEC)
13713
TRACKING HI PASS
CROSSOVER
FREQ 1-2
SEGMENT 2
SW2-SERVO


NETWORK
AGC AMPLIFIER C-3739
SEGMENT 3 SW3-SERVO

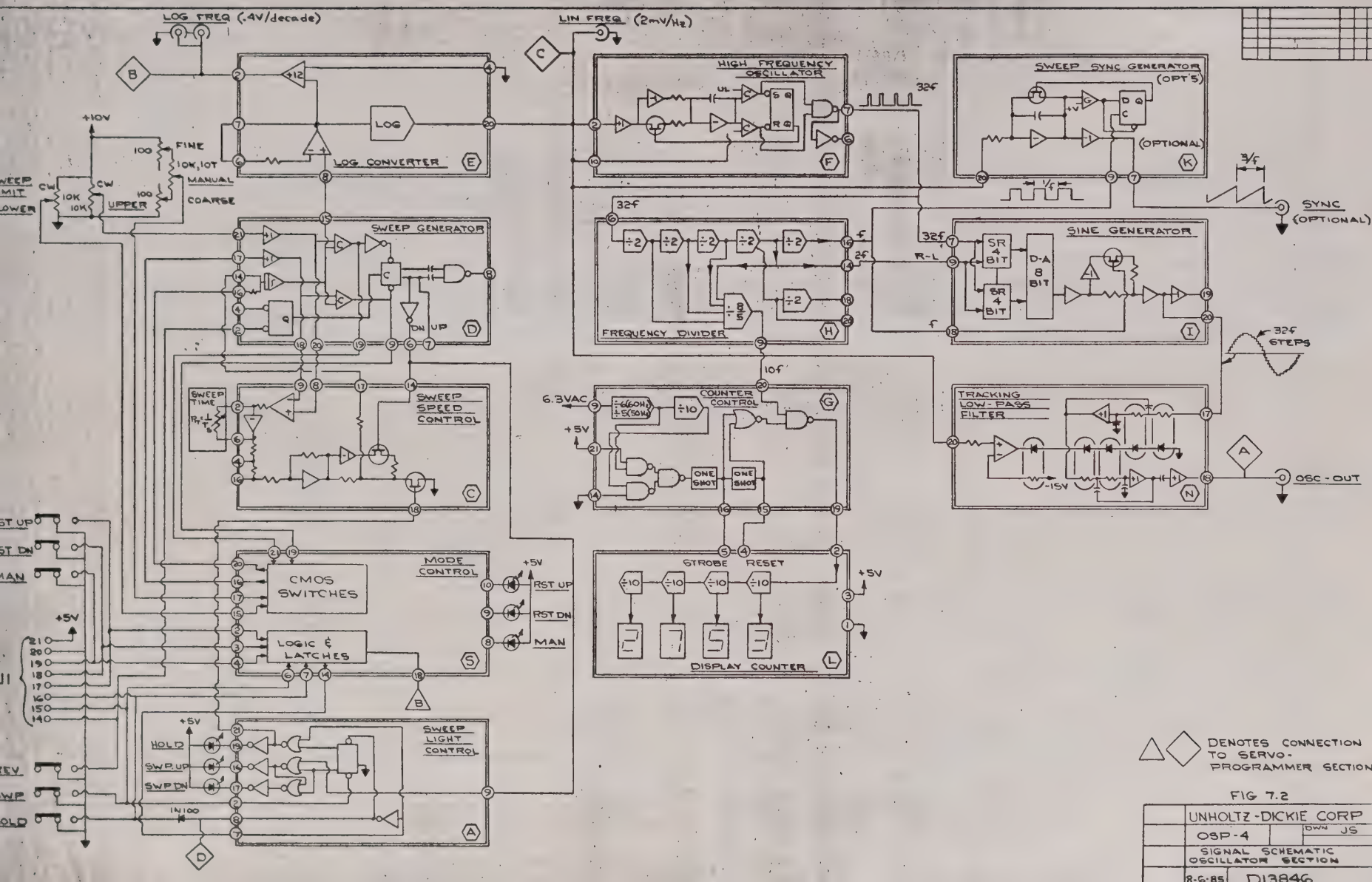


FIG 7.2

	UNHOLTZ-DICKIE CORP	
	OSP-4	DWN JS
	SIGNAL SCHEMATIC OSCILLATOR SECTION	
	R-G-BS D13846	

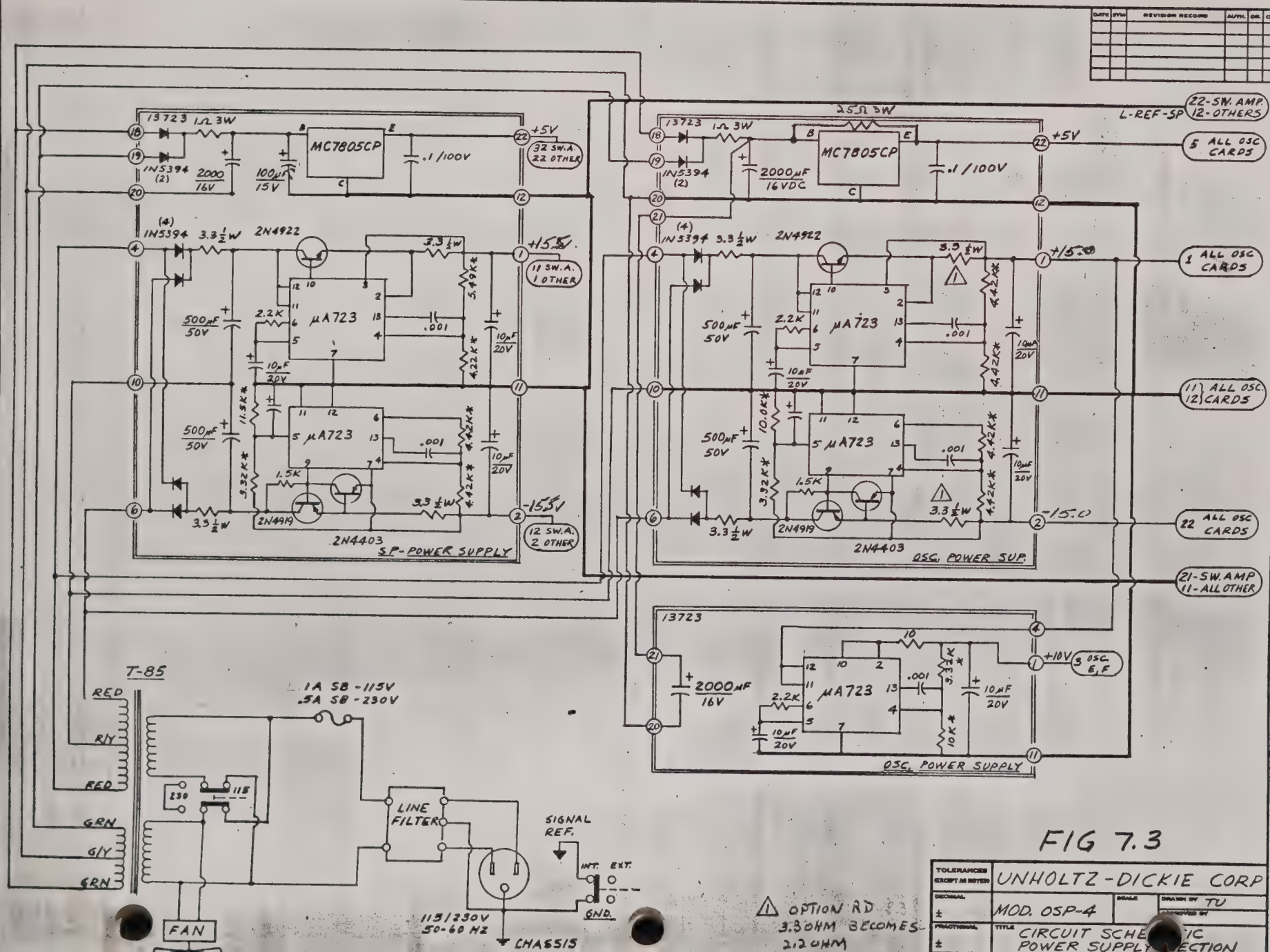


FIG 7.3

TOLERANCES EXCEPT AS NOTED	UNHOLTZ-DICKIE CORP
DECIMAL ±	MOD. OSP-4
FRACTIONAL ±	TITLE CIRCUIT SCHEMATIC POWER SUPPLY SECTION

DATE	SYM	REVISION RECORD	AUTH	CK.

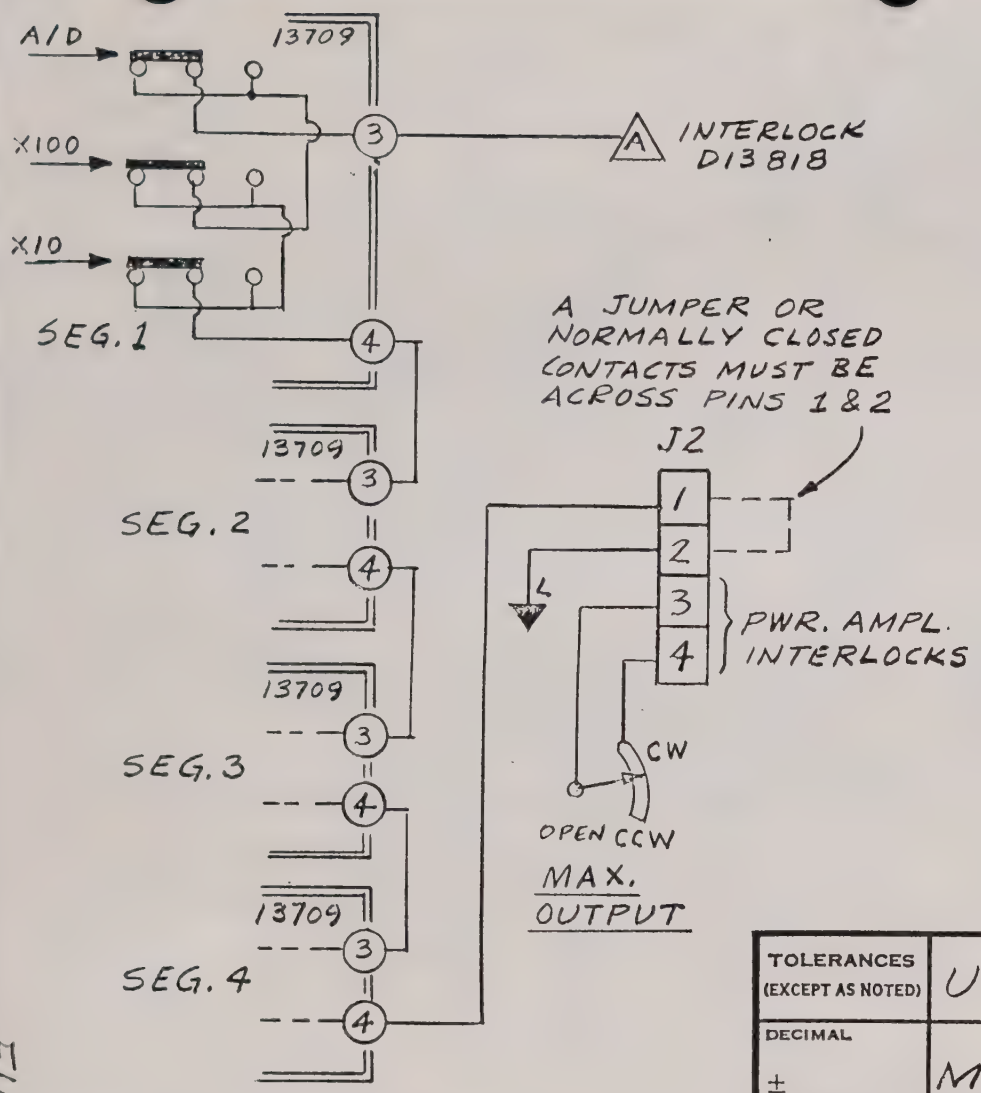
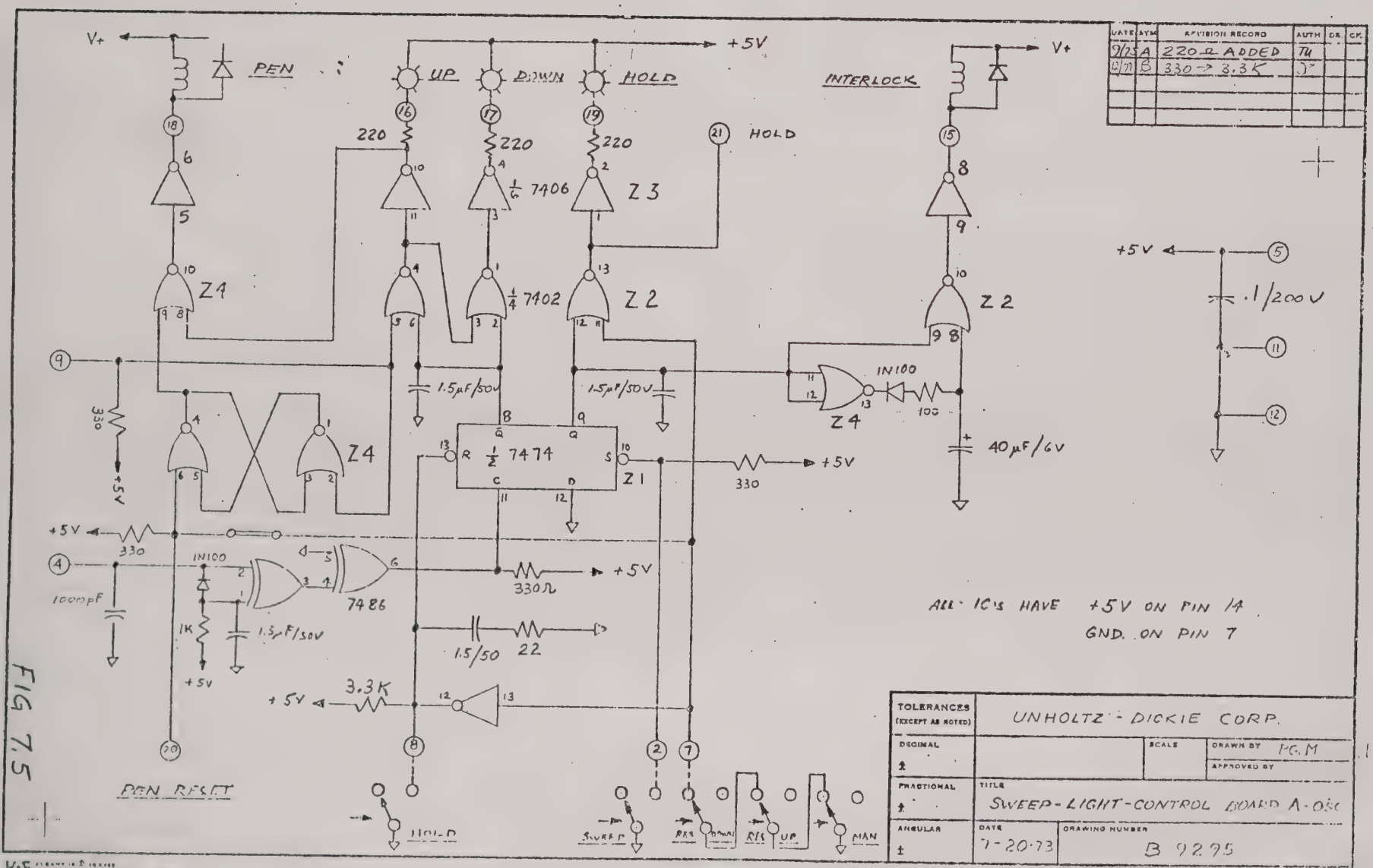


FIG. 7.4

TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ-DICKIE CORP.		
DECIMAL ±	MOD. OSP-4	SCALE —	DRAWN BY TU APPROVED BY
FRACTIONAL ±	TITLE SIGNAL SCHEMATIC INTERLOCK CIRCUITS		
ANGULAR ±	DATE 3-19-80	DRAWING NUMBER A13847	

K&E CRYSTALENE ® 10 5465
MADE IN U.S.A.

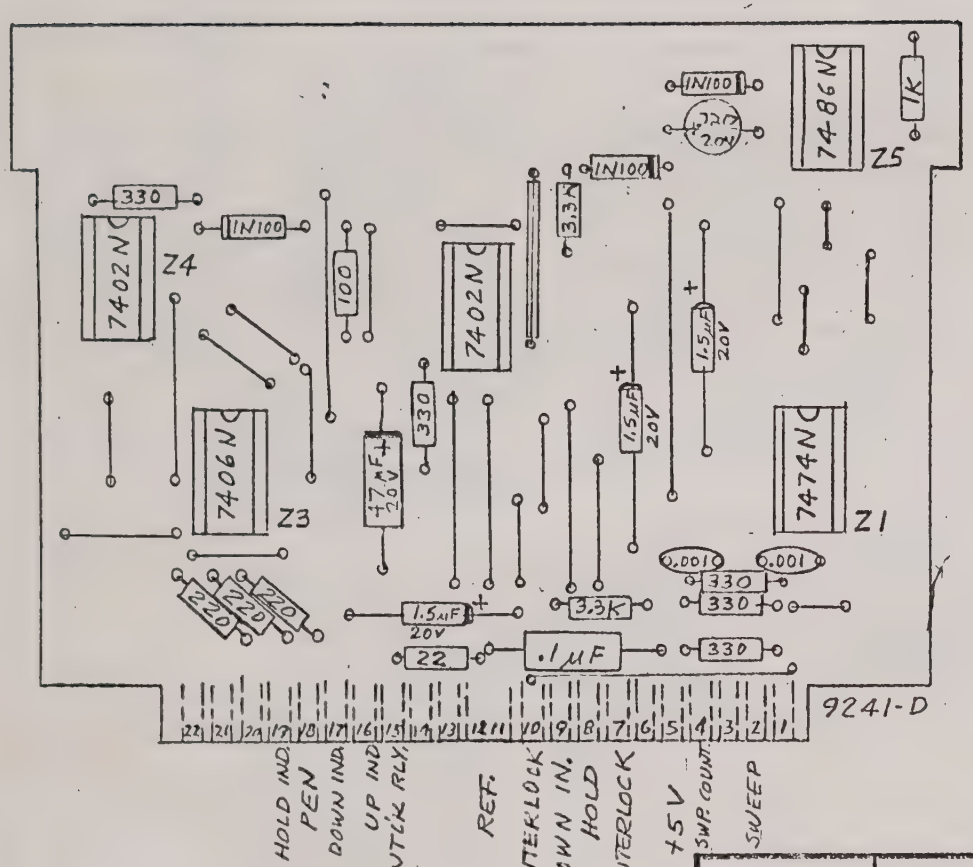


DATE	SYM	REVISION RECORD	AUTH	CK
9/25	A	220Ω ADDED	TM	
10/71	B	330 → 3.3K	JF	

TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ - DICKIE CORP.		
DECIMAL ±		SCALE	DRAWN BY P.G.M
FRACTIONAL ±	TITLE SWEEP-LIGHT-CONTROL BOARD A-05C		APPROVED BY
ANGULAR ±	DATE 7-20-73	DRAWING NUMBER B 9275	

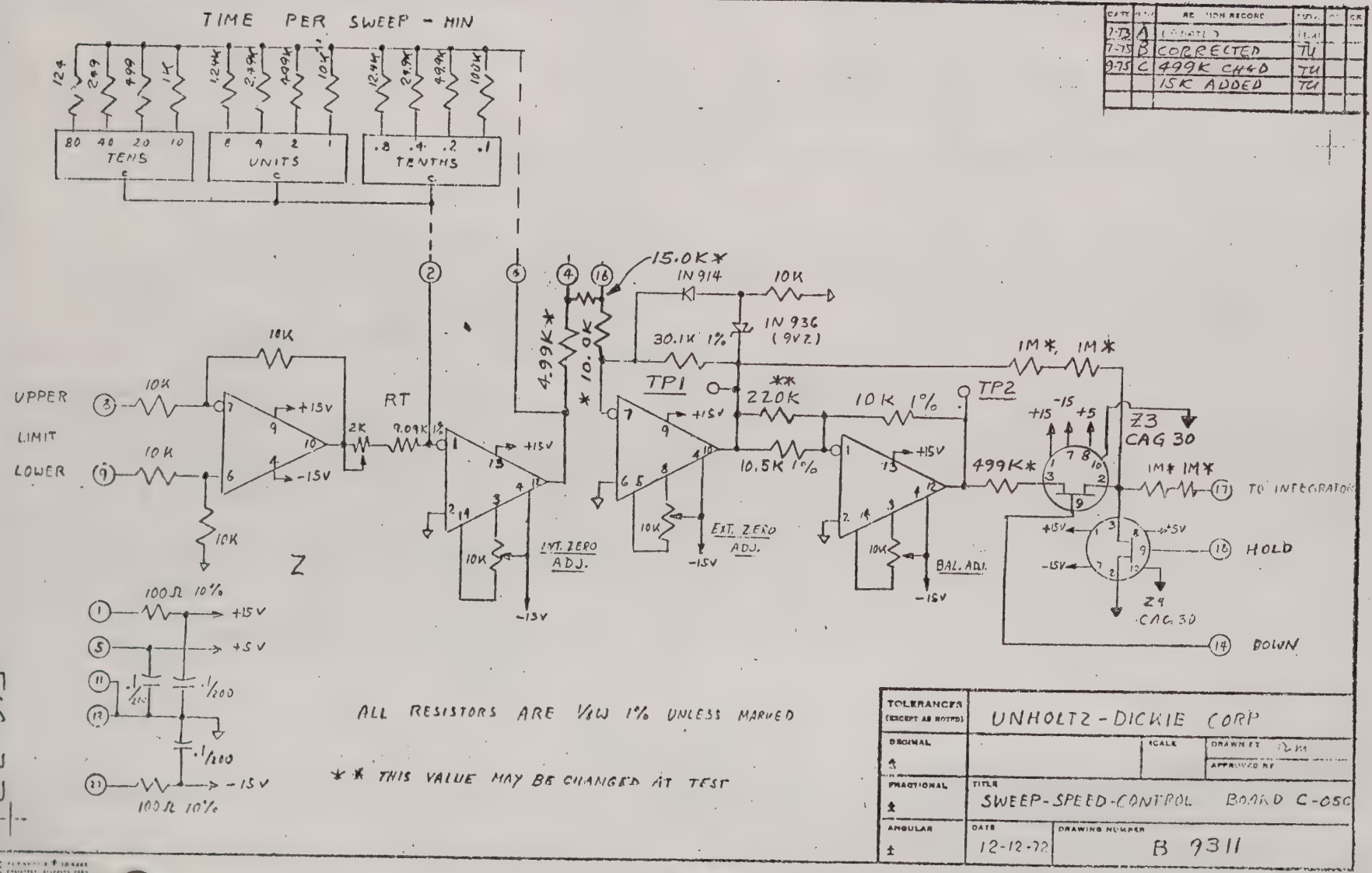
FIG 7.5

DATE	SYM	REVISION RECORD	AUT		CK.
5-75	A	BOARD DIM. CHGD	TU		
		220Ω RES ADDED	TU		
12/77	B	330 → 3.3K	TU		
5/79	C	Z5 CKT. ADDED	TU		
9/84	D	47μF/20V WAS 22μF/10V			



TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ-DICKIE CORP.		
DECIMAL ±	OSP-4	SCALE	DRAWN BY TU APPROVED BY
FRACTIONAL ±	TITLE COMPONENT LAYOUT A-OSC SWEEP LIGHT CONTROL		
ANGULAR ±	DATE 5-15-75	DRAWING NUMBER A9297	

FIG 7.6

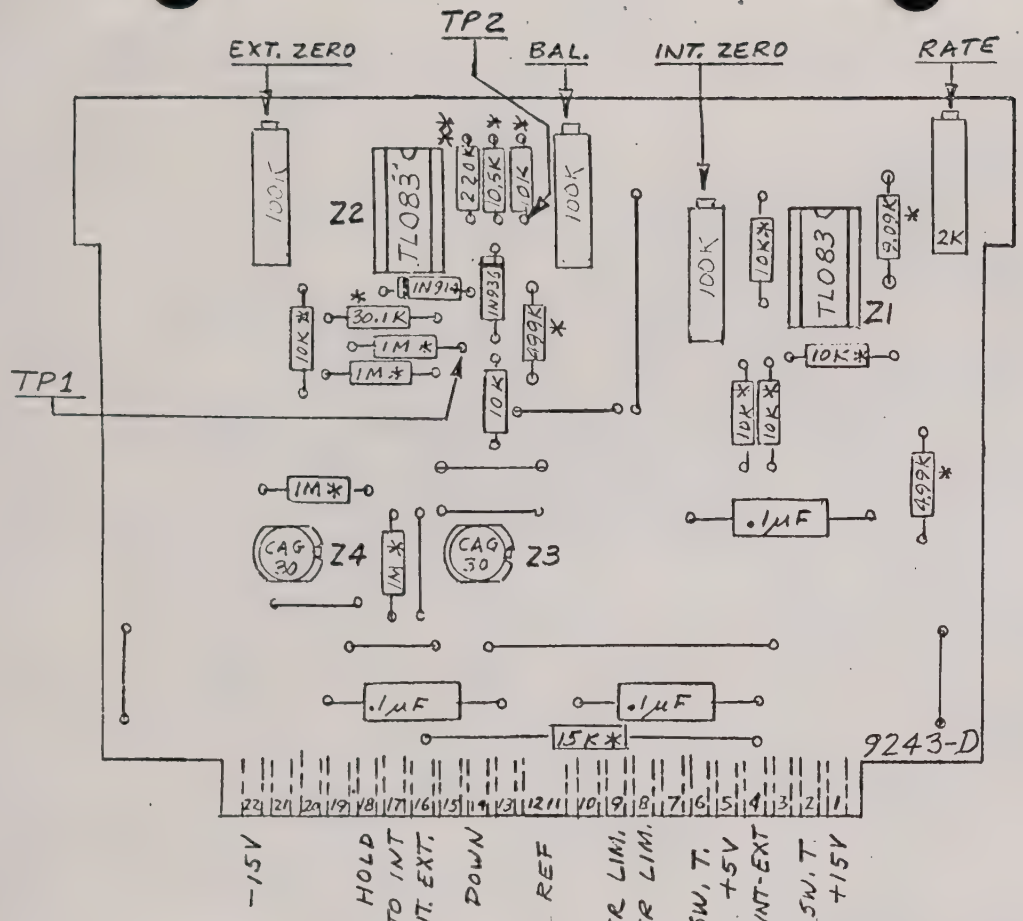


DATE		REVISION RECORD			
1-73	A	[illegible]			
7-75	B	CORRECTED	TU		
9-75	C	499K CHGD	TU		
		15K ADDED	TU		

TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ-DICKIE CORP		
DECIMAL ±		SCALE	DRAWN BY / APPROVED BY
FRACTIONAL ±	TITLE SWEEP-SPEED-CONTROL BOARD C-050		
ANGULAR ±	DATE 12-12-72	DRAWING NUMBER B 9311	

FIG. 7.7

DATE	SYM	REVISION RECORD	AUTH.	CK.	
5-75	A	BOARD DIM. CHGD	TU		
		15K 1% (16 TO 4)	TU		
9-75	B	499K* POS. CHGD	TU		
3-81	C	MA747→TL083	TU		



OSC C

** ADJUSTED AT FACTORY

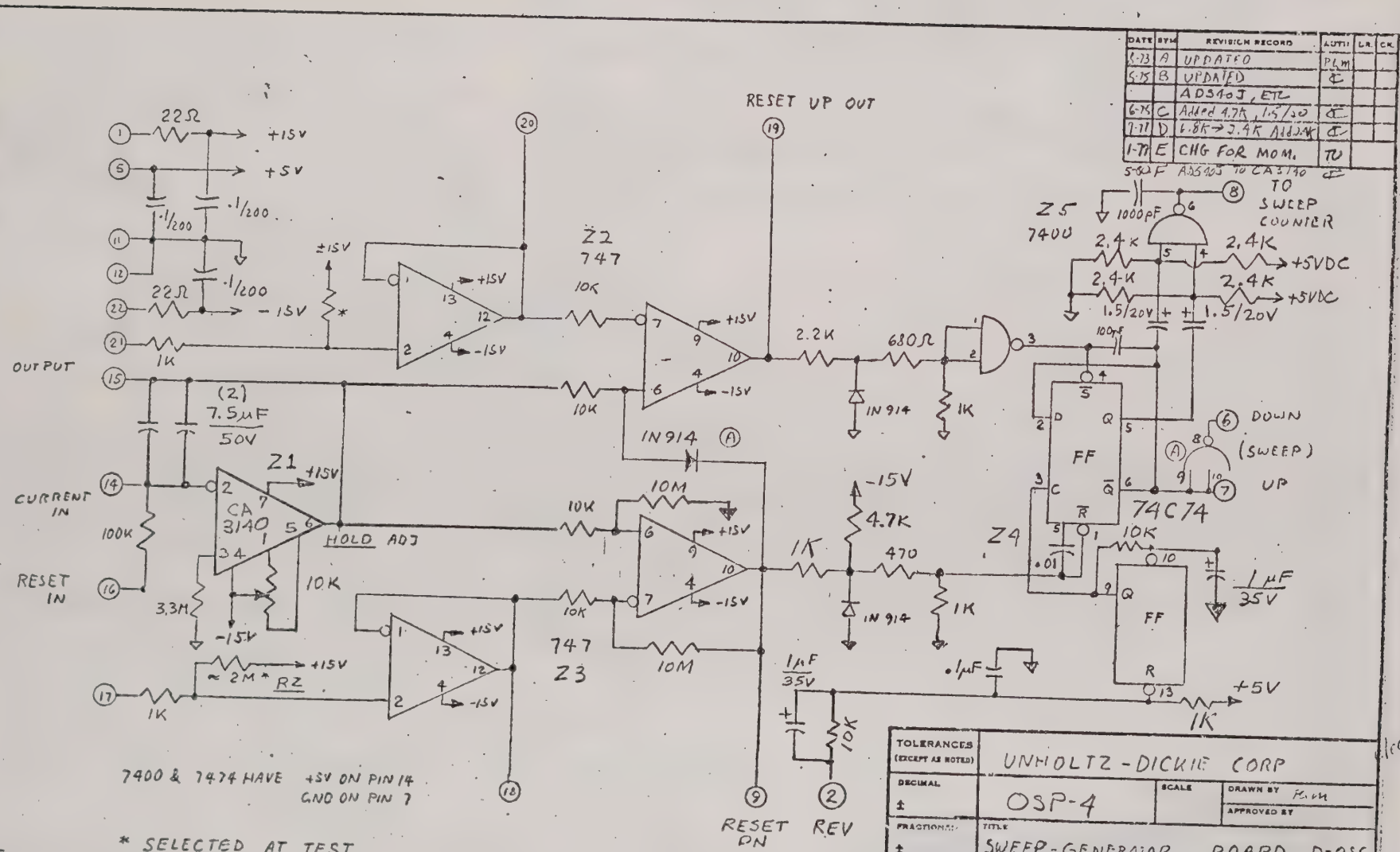
* 1% METAL FILM.

TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ-DICKIE CORP.		
DECIMAL ±	OSP-4	SCALE	DRAWN BY TU APPROVED BY
FRACTIONAL ±	TITLE COMPONENT LAYOUT C-OSC SWEEP SPEED CONTROL		
ANGULAR ±	DATE 5-15-75	DRAWING NUMBER A9298 C	

FIG 7.8

CRYSTALENE ® 10-5465

MADE IN U.S.A.



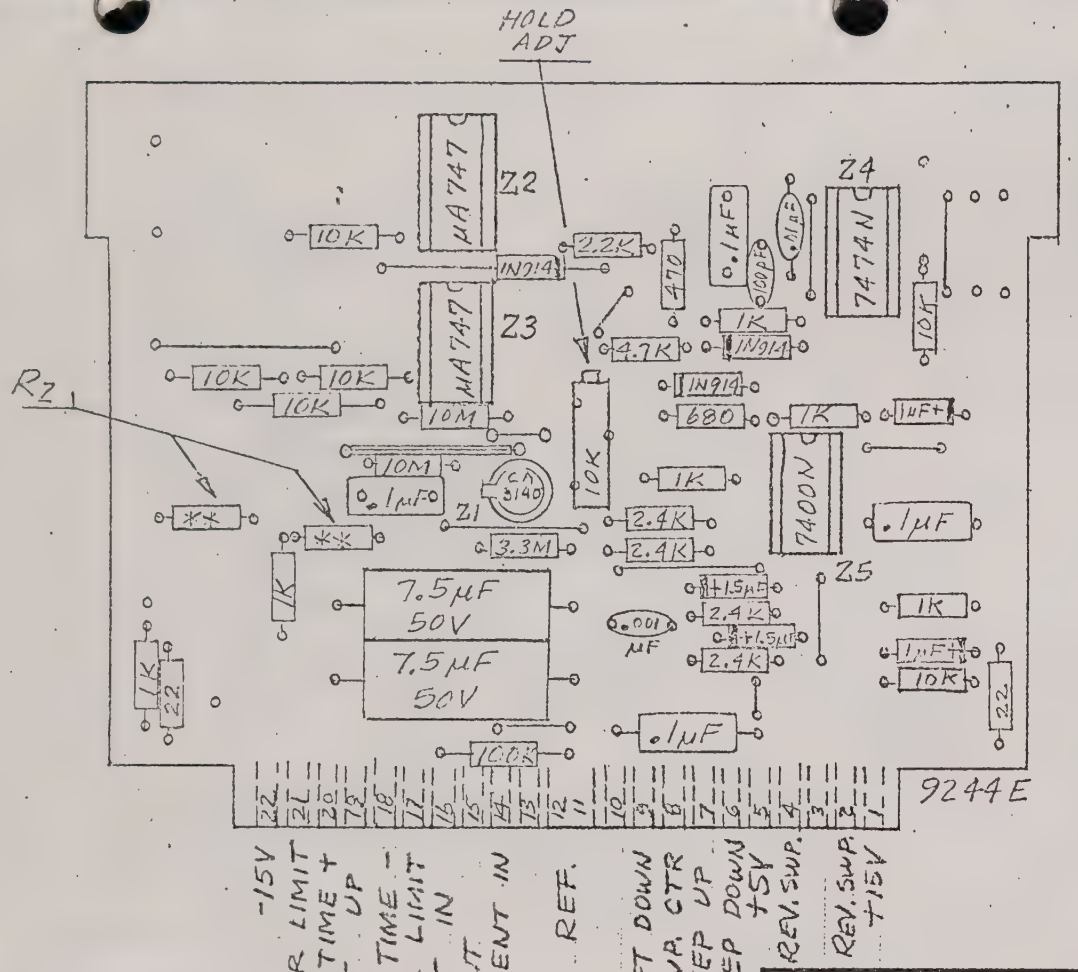
DATE	BY	REVISION RECORD	AUTH	LR	CK
5-73	A	UPDATED	P.L.M		
5-75	B	UPDATED			
		AD340J, ETC			
6-76	C	Added 4.7K, 1.5/20			
7-77	D	6.8K→2.4K Added 2K			
1-78	E	CHG FOR MOM.	TV		

5-80 F ADS405 TO CA3140

TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ-DICKIE CORP		
DECIMAL ±	OSP-4	SCALE	DRAWN BY P.L.M APPROVED BY
FRACTIONAL ±	TITLE SWEEP-GENERATOR BOARD D-OSC		
ANGULAR ±	DATE 7-20-73	DRAWING NUMBER B 9296	

Fig. 7.9

DATE	SYM	REVISION RECORD	CH	DR.	CK.
5-75	B	AD590J +10M	TU		
6-75	C	4.7K ADDED 1.5/20	TC		
1-76	D	2.4K ADDED	TU		
5-79	E	CKT. CHG Y.A.	TU		
6-80	F	CHG AD590J TO CA3140	[illegible]		
11-82	G	CHG REV CKT	[illegible]		



TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ-DICKIE CORP.		
DECIMAL ±	OSP-4	SCALE 1	DRAWN BY TU APPROVED BY
FRACTIONAL ±	TITLE COMPONENT LAYOUT D-OSC SWEEP GENERATOR		
ANGULAR ±	DATE 5-10-79	DRAWING NUMBER A 9299	

FIG 7.10

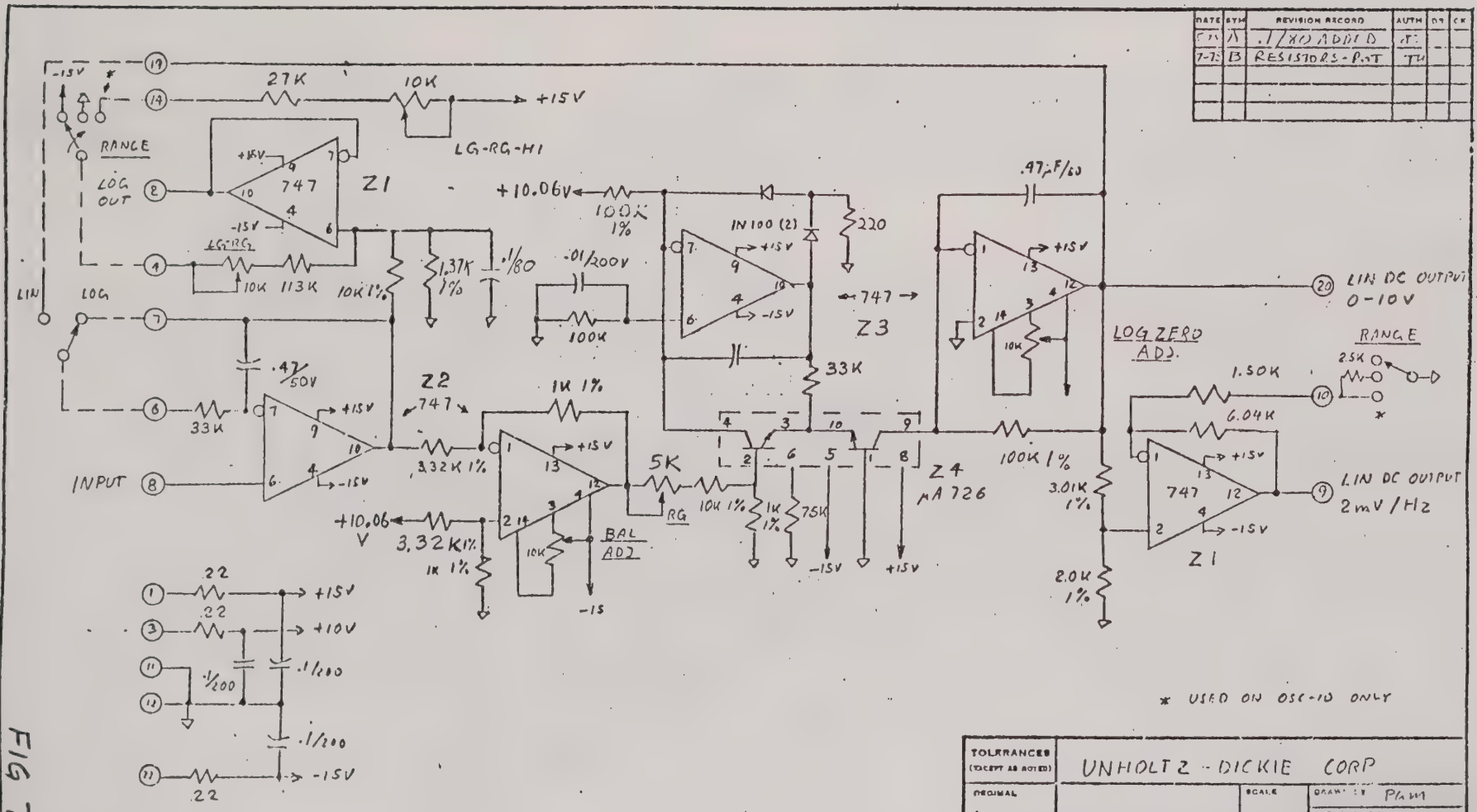
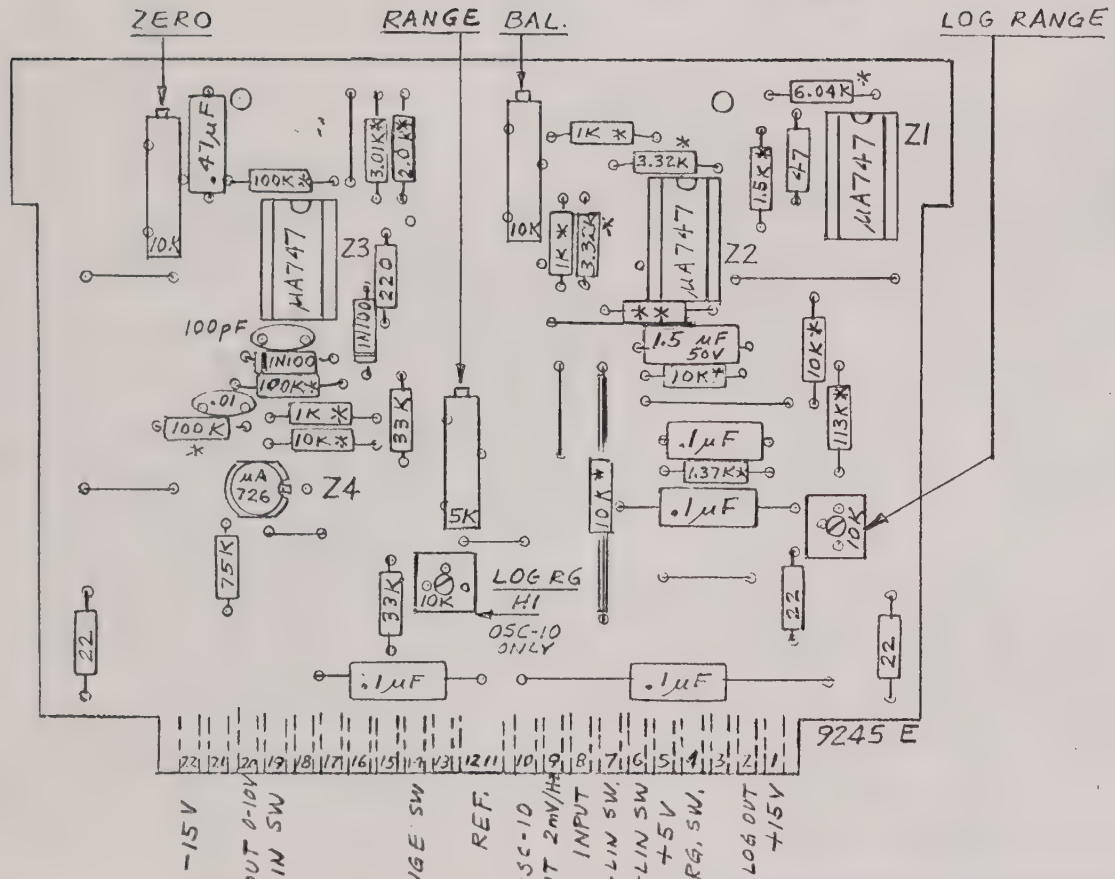

REVISION RECORD
DATE BY REVISION RECORD AUTH DR CK
7-73 A .1/X0 ADDED JT -
7-73 B RESISTORS - P.U.T TU
-15V
RANGE
LOG OUT
LIN
LOG
INPUT
27K
10K
+15V
LG-RG-HI
Z1
747
+10.06V
100K 1%
IN100 (2)
220
.47µF/6V
Z3
LIN DC OUTPUT 0-10V
LOG ZERO ADJ.
RANGE
25K
1.50K
6.04K
.47/50V
33K
Z2
1K 1%
3.32K 1%
5K
RG
10K 1%
1K 1%
75K
Z4 µA726
100K 1%
3.01K 1%
2.0K 1%
LIN DC OUTPUT 2mV/Hz
BAL ADJ
10K
3.32K 1%
1K 1%
22
.1/200
.01/200V
1.37K 1%
10K 1%
10K 113K
* USED ON OSC-10 ONLY
TOLERANCES (EXCEPT AS NOTED)
DECIMAL ±
FRACTIONAL ±
ANGULAR ±
UNHOLTZ - DICKIE CORP
SCALE
DRAWN PLM
APPROVED BY
TITLE
LOG CONVERTER BOARD E - OSC
DATE 5-2-73
DRAWING NUMBER B 9289

FIG 7.11

DATE	SYM	REVISION RECORD	AUTH		CK.
5-75	A	NEW BOARD - 2 COMPS.	TU		
7-75	B	3.32K ⇒ 3.57K			
		2K POT ⇒ 5K POT	TU		
		100K ⇒ 105K.			
11-75	C	105K ⇒ 100K 3.57K ⇒ 3.32K	TU		



* 1% METAL FILM

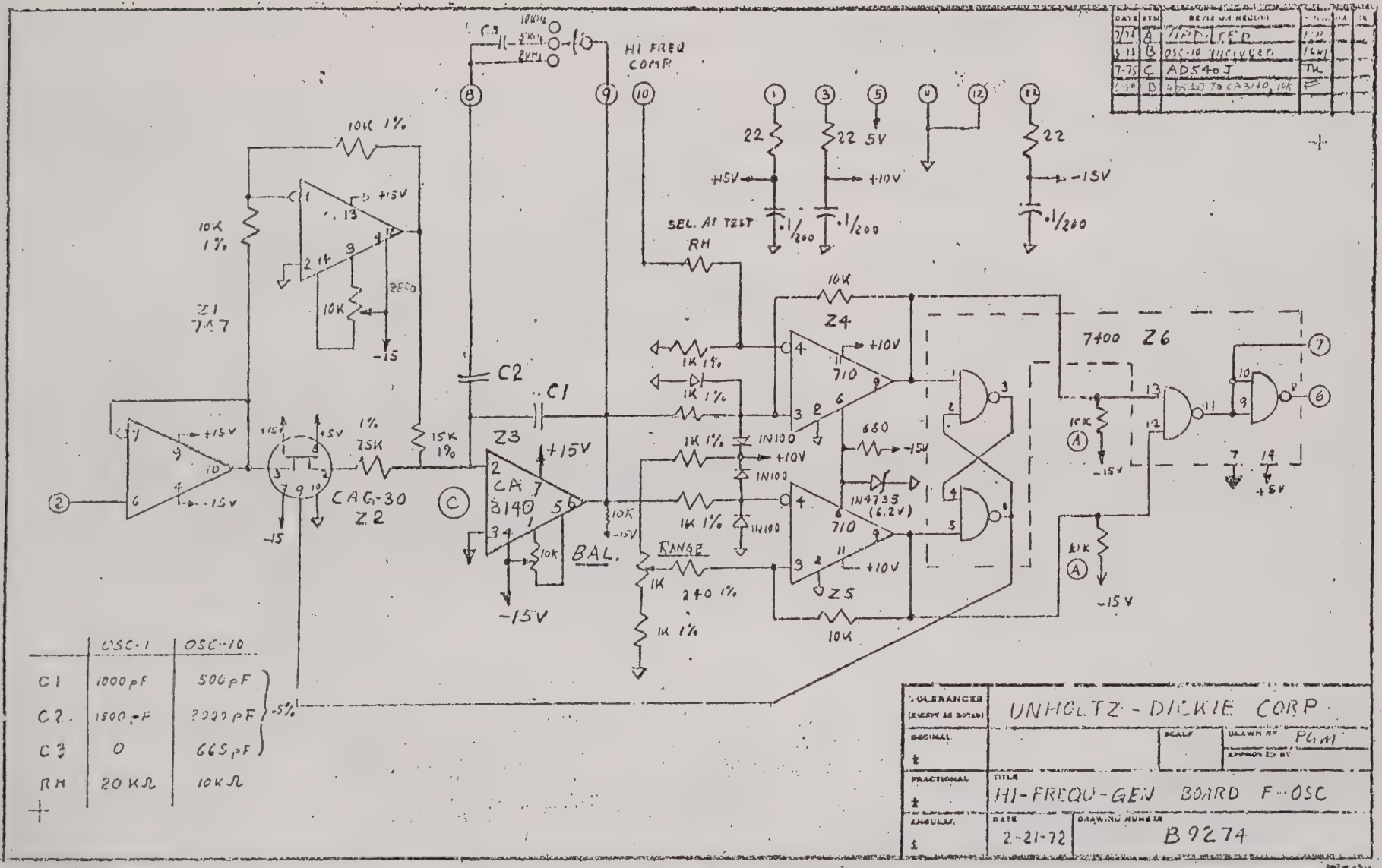
** FACTORY SELECT

TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ-DICKIE CORP.		
DECIMAL ±	OSC-1 OSP-4	SCALE	DRAWN BY TU
			APPROVED BY
FRACTIONAL ±	TITLE COMPONENT LAYOUT E-OSC LOG CONVERTER		
ANGULAR ±	DATE 5-15-75	DRAWING NUMBER A9290	

FIG 7.12

CRYSTALENE ® 10-5403

MADE IN U. S. A.

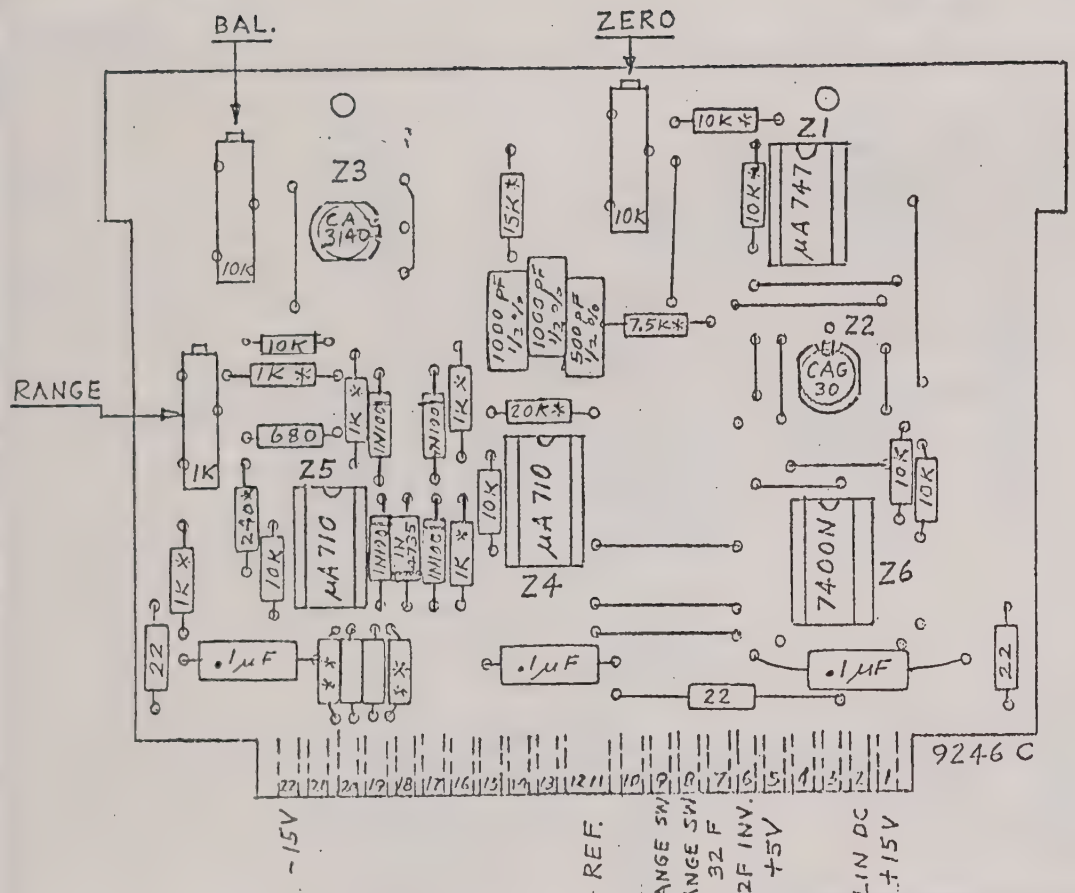


	OSC-1	OSC-10	
C1	1000 pF	500 pF	
C2	1500 pF	2000 pF	±5%
C3	0	665 pF	
RH	20 KΩ	10 KΩ	

DATE	BY	REVISION RECORD		
7/71	A	ADDED		
5-72	B	OSC-10 INCLUDED		
7-72	C	AD540J		
1-73	D	ADDED TO CA3140, 10K		

TOLERANCES (EXCEPT AS STATED)	UNHOLTZ-DICKIE CORP.
DECIMAL ±	SCALE
FRACTIONAL ±	TITLE: HI-FREQU-GEN BOARD F-OSC
ANGULAR ±	DATE: 2-21-72
	DRAWING NUMBER: B9274

DATE	STR.	
5-75	D	23, SOCKETS CHGD
8-80	E	AD540J TO CA3140, 10K



* 1% METAL FILM

* FACTORY SELECT

FIG 7.14

TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ-DICKIE CORP.	
DECIMAL ±	OSC-1 OSP-4	SCALE / DRAWN BY TU / APPROVED BY
FRACTIONAL ±	TITLE COMPONENT LAYOUT F-OSC HIGH FREQ. GENERATOR	
ANGULAR ±	DATE 5-14-75	DRAWING NUMBER A 9275

MADE IN U.S.A.

DATE	BY	REVISION RECORD	AUTH	LR	CK

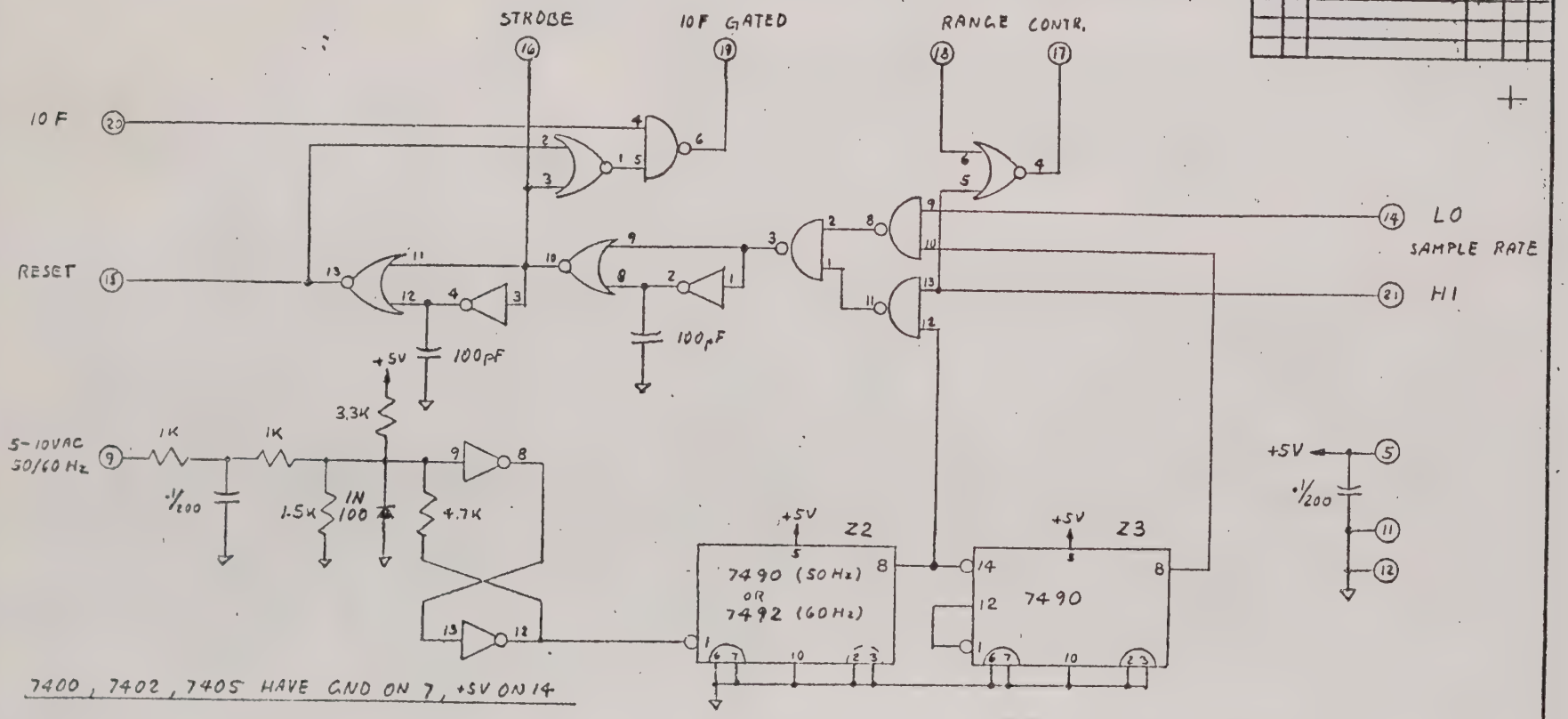
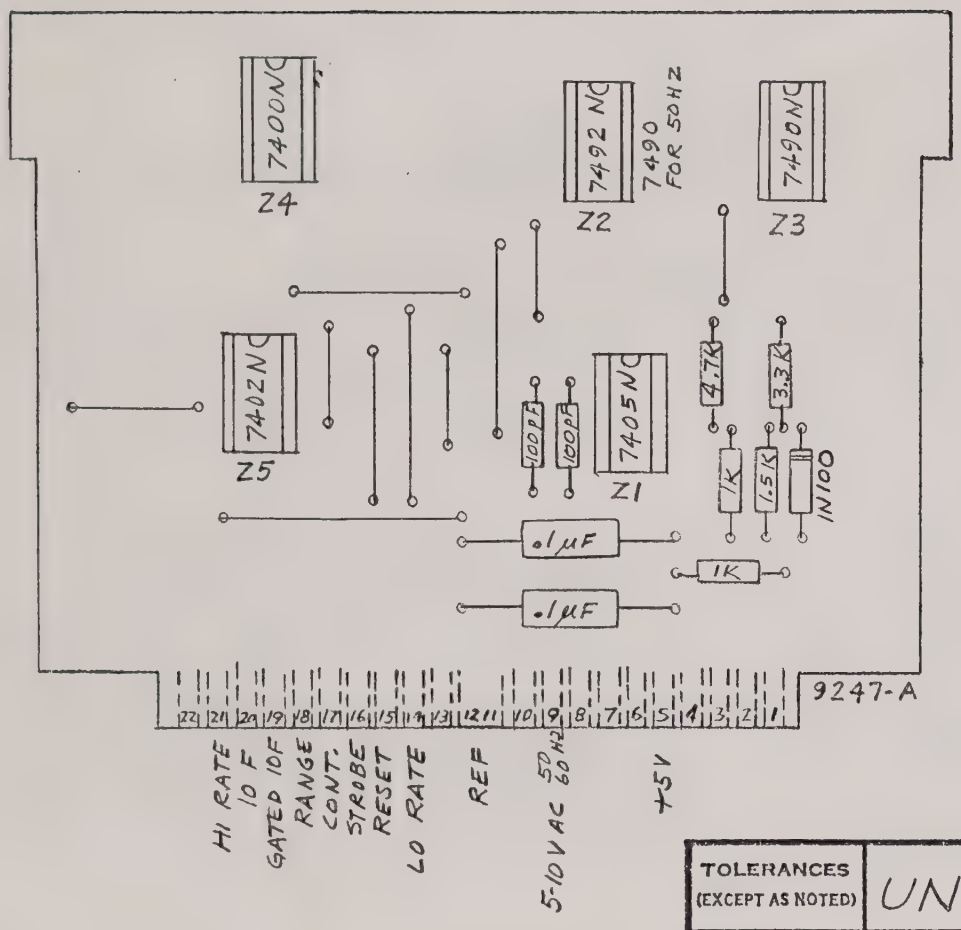


FIG 7.15

TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ - DICKIE CORP		
DECIMAL ±		SCALE	DRAWN BY PLM
			APPROVED BY
FRACTIONAL ±	TITLE: COUNTER-CONTROL BOARD G-OSC		
ANGULAR ±	DATE 4-29-70	DRAWING NUMBER B 9234	

DATE	SYM	REVISION RECORD	AUTH	CK.
5-75	B	BOARD DIM. CHGD.	TU	
		IN3122 → IN100	TU	

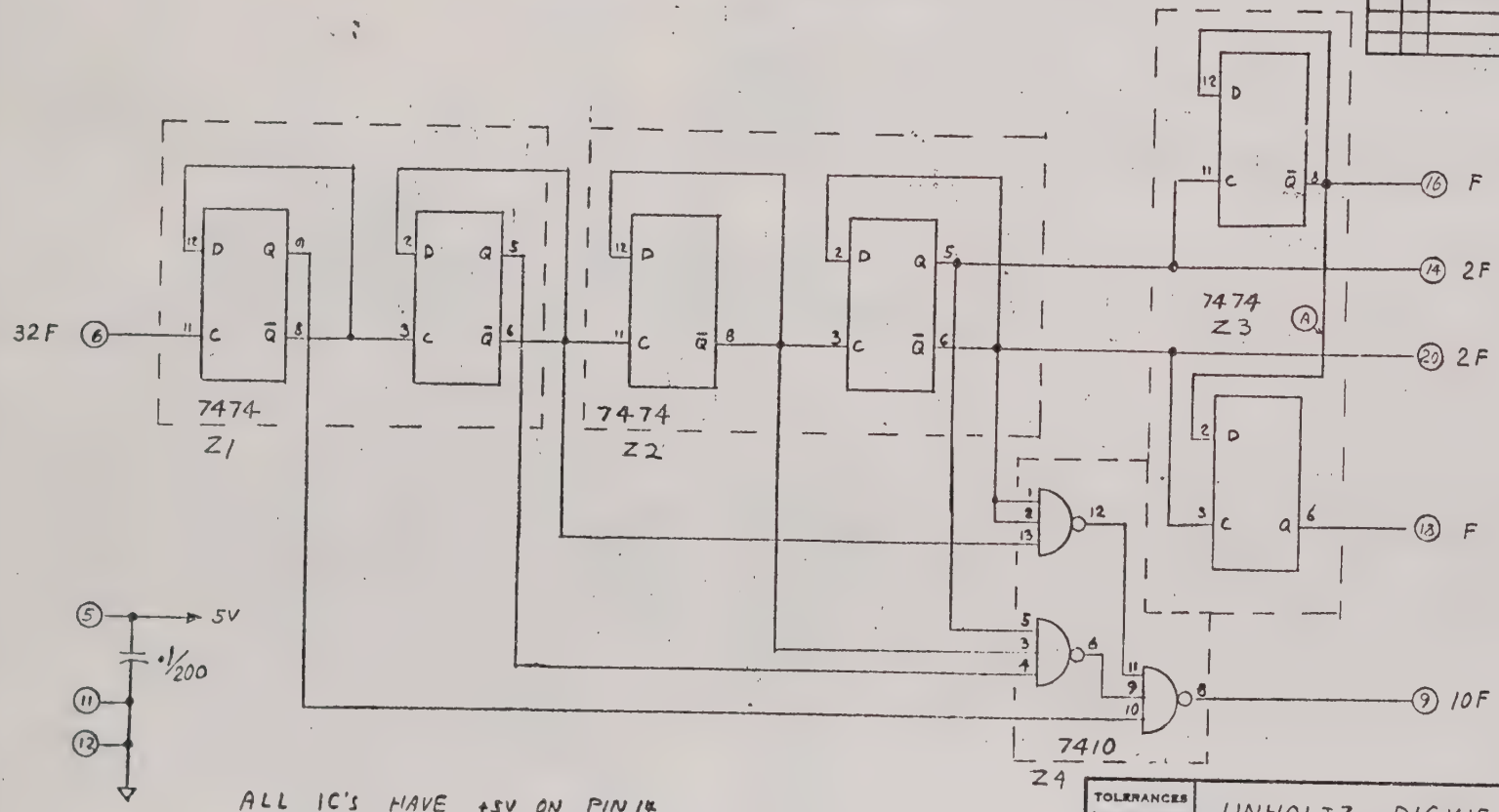


TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ-DICKIE CORP.		
DECIMAL ±	OSC-1 OSP-4	SCALE	DRAWN BY TU APPROVED BY
FRACTIONAL ±	TITLE COMPONENT LAYOUT G-OSC COUNTER CONTROL		
ANGULAR ±	DATE 5-15-75	DRAWING NUMBER A9261	

FIG 7.16

CRYSTALENE © 10 5465
MADE IN U.S.A.

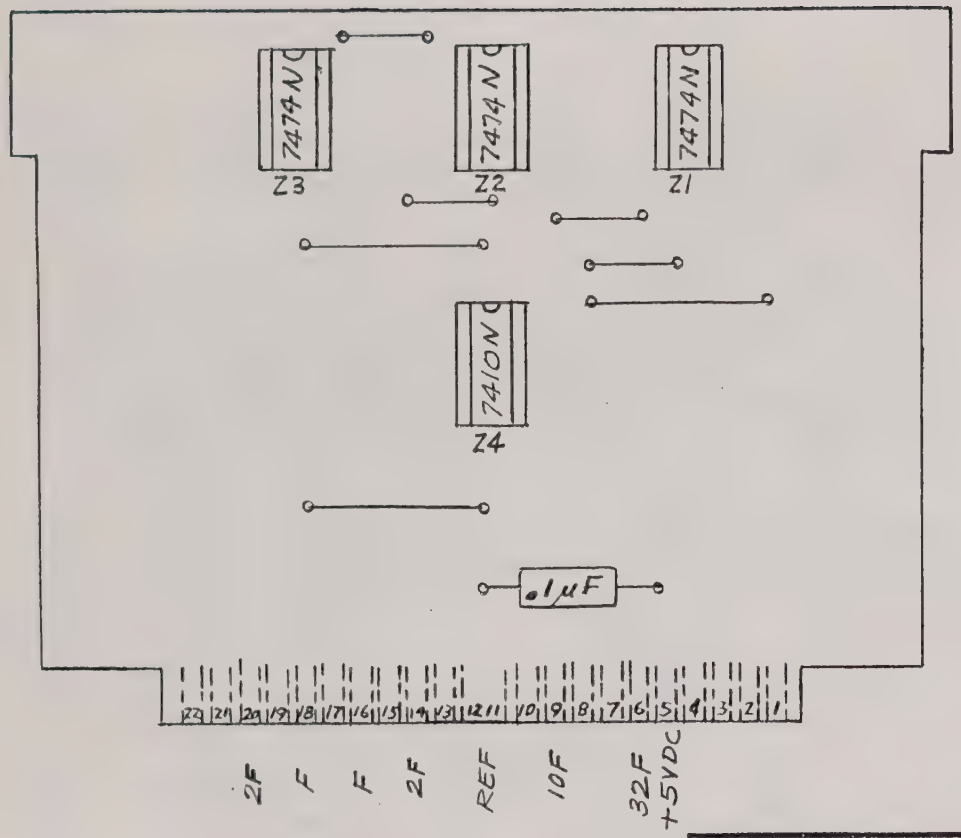
DATE	SYM	REVISION RECORD	AUTH	CR	CK
7-21	A	Z3-2 was conn to Z3-6	PLM		
7-25	B	ERROR CORR	TU		



TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ - DICKIE CORP		
DECIMAL ±		SCALE	DRAWN BY PLM
			APPROVED BY
FRACTIONAL ±	TITLE FREQU-DIVIDER BOARD H-OSC		
ANGULAR ±	DATE 4-28-71	DRAWING NUMBER B 9235	

FIG 7.17

DATE	SYM	REVISION RECORD	AUTH	CK.
5-75	A	BOARD SIZE CHGD	TU	



TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ-DICKIE CORP.		
DECIMAL ±	OSC-1 OSP-4	SCALE	DRAWN BY TU APPROVED BY
FRACTIONAL ±	TITLE COMPONENT LAYOUT H-OSC FREQUENCY DIVIDER		
ANGULAR ±	DATE 5-15-75	DRAWING NUMBER A9262	

FIG. 7.18

CRYSTALENE ® 10 5465

MADE IN U. S. A.

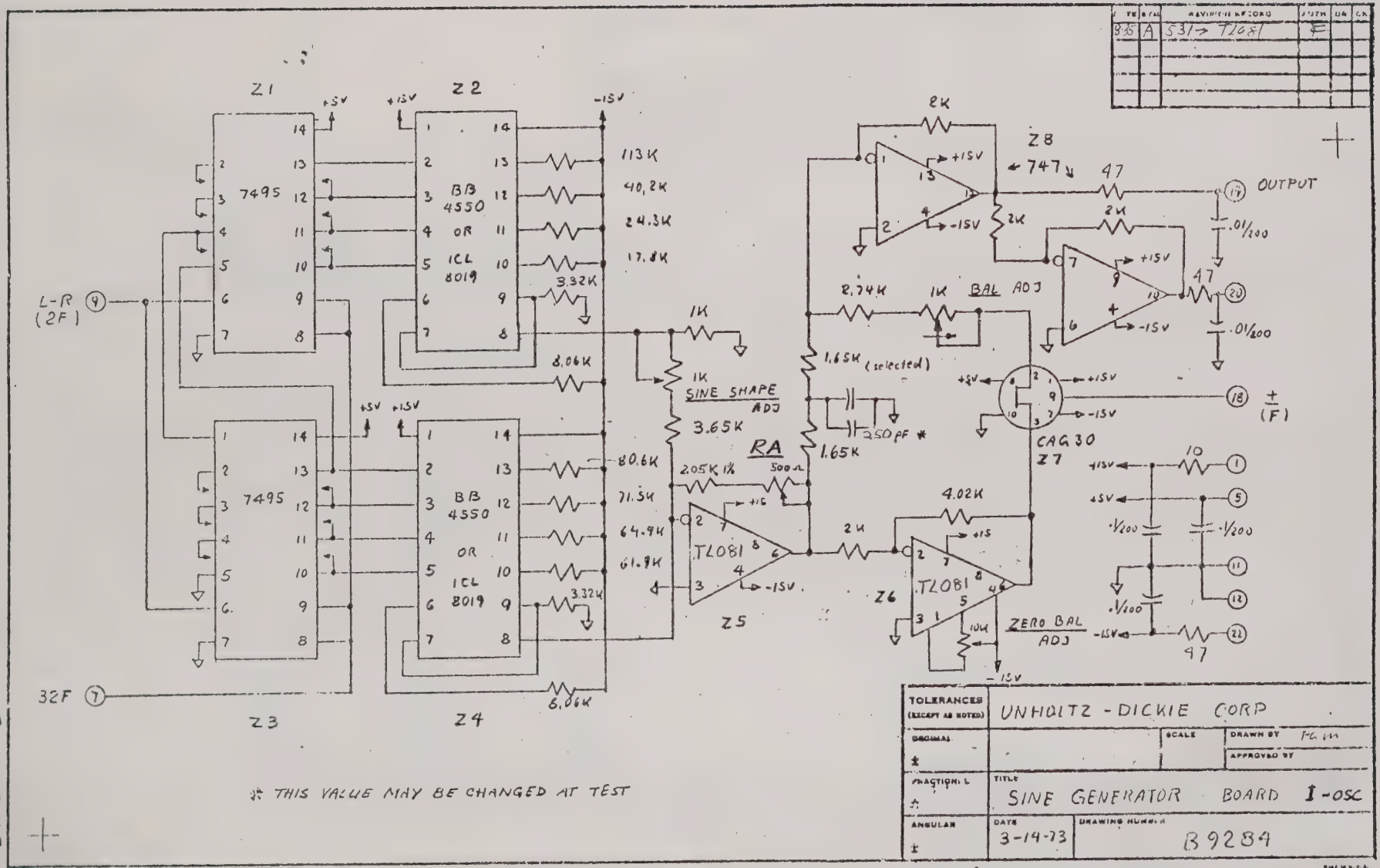

Z1
Z2
7495
BB 4550 OR ICL 8019
+5V
+15V
-15V
113K
40.2K
24.3K
17.8K
3.32K
8.06K
1K
1K SINE SHAPE ADJ
3.65K
RA
2.05K 1%
500Ω
80.6K
71.5K
64.9K
61.9K
3.32K
6.06K
L-R (2F)
32F
Z3
Z4
Z5
TL081
2K
Z6
4.02K
Z7
CA3130
Z8
747
8K
47
OUTPUT
.01/200
2.74K
1K BAL ADJ
1.65K (selected)
250pF *
+ (F)
10
.1/200
10K
ZERO BAL ADJ
* THIS VALUE MAY BE CHANGED AT TEST
TOLERANCES (EXCEPT AS NOTED)
DECIMAL ±
FRACTIONAL ±
ANGULAR ±
UNHOLTZ - DICKIE CORP
SCALE
DRAWN BY
APPROVED BY
TITLE
SINE GENERATOR BOARD 1-OSC
DATE 3-14-73
DRAWING NUMBER B9284

FIG 7.19

DATE	SYM	REVISION RECORD	AUT		CK.
5-75	A	BOARD SIZE CHGD	TU		
8-85	B	531 → TL081	T		

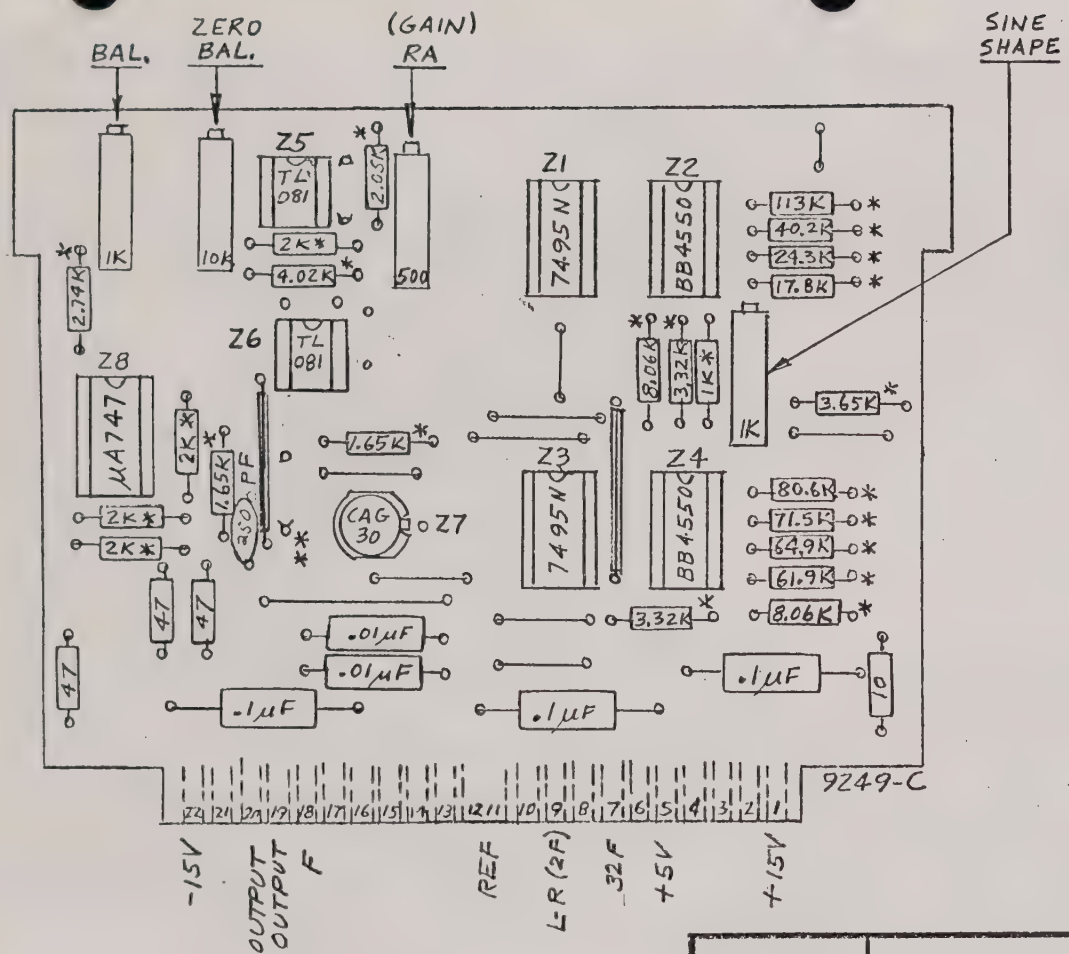
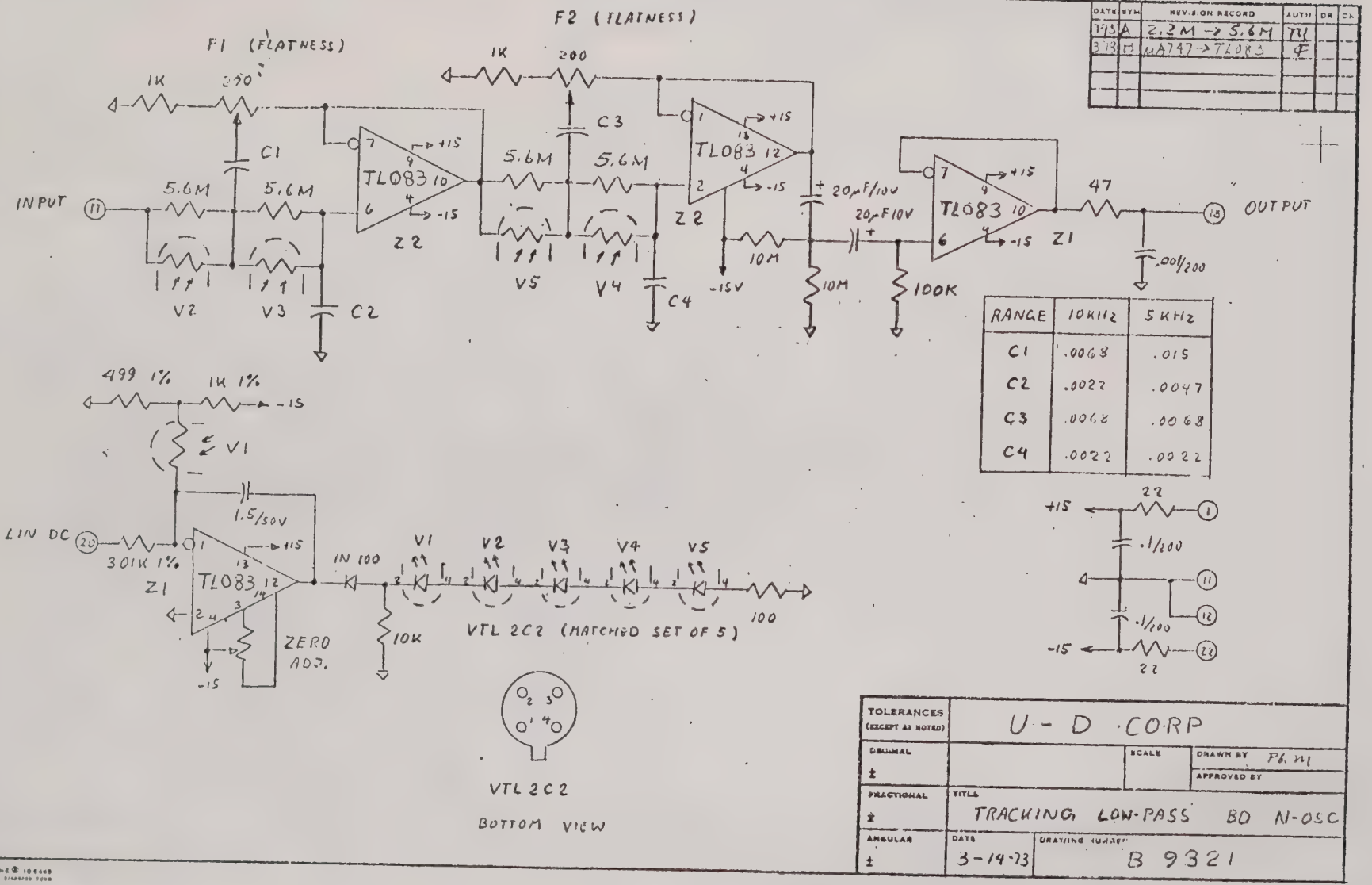


FIG 7.20

* 1% METAL FILM
** CAP. VALUE ADJUSTED AT FACTORY

TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ-DICKIE CORP.		
DECIMAL ±	OSC-1 OSP-4	SCALE	DRAWN BY TU
			APPROVED BY
FRACTIONAL ±	TITLE COMPONENT LAYOUT I-OSC SINE GENERATOR.		
ANGULAR ±	DATE 5-16-75	DRAWING NUMBER A9286	

CRYSTALONE 10 3463
MADE IN U.S.A.

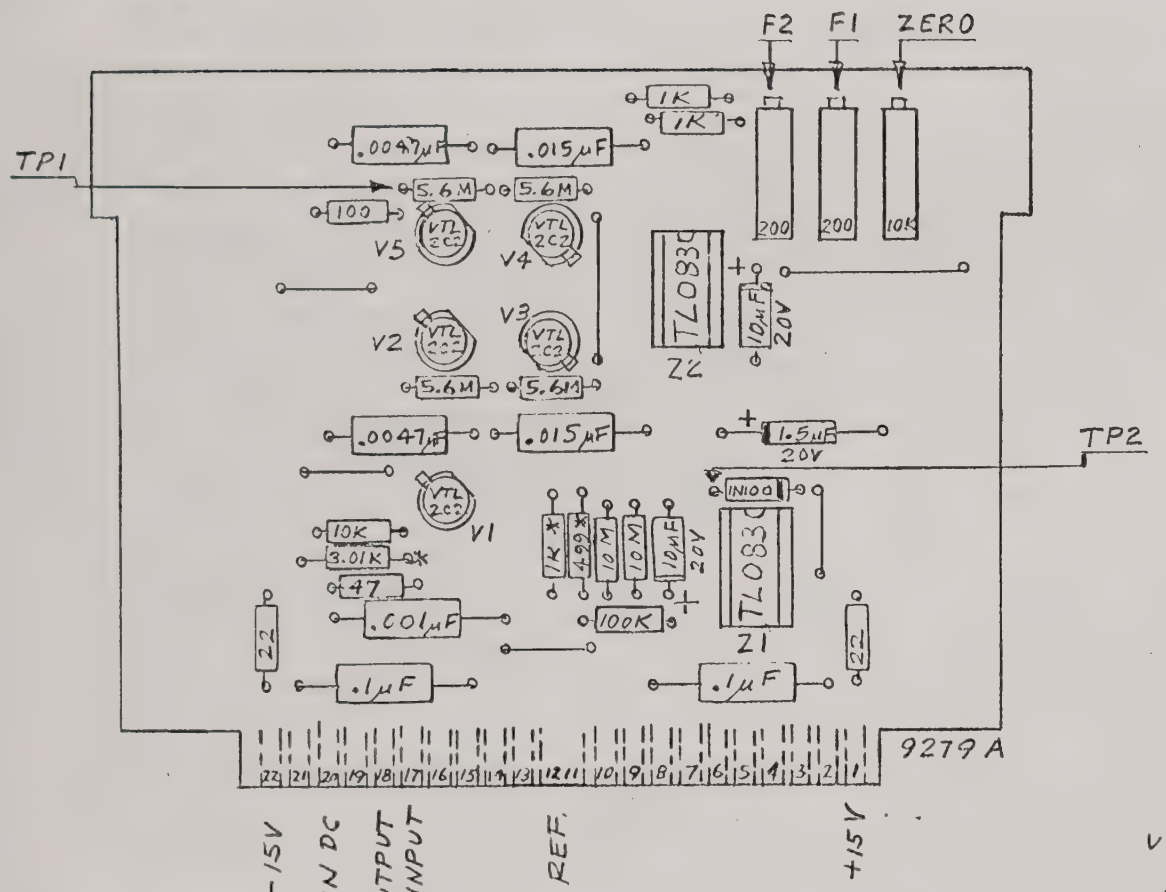


DATE	BY	REVISION RECORD	AUTH	DR	CK
7/15	A	2.2M → 5.6M	TM		
8/73	B	μA747 → TL083	CF		

TOLERANCES (EXCEPT AS NOTED)	U - D CORP		
DECIMAL ±		SCALE	DRAWN BY P.G. M.
			APPROVED BY
FRACTIONAL ±	TITLE: TRACKING LOW-PASS BD N-OSC		
ANGULAR ±	DATE: 3-14-73	GRATING NUMBER: B 9321	

FIG 7.21

DATE	SYM	REVISION RECORD	AUTH.	CK.
5-75	A	BOARD SIZE CHGD	TU	
6-75	B	(9) 2.2M ⇒ 5.6M	TU	
3-78	C	μA747 ⇒ TL083	TU	



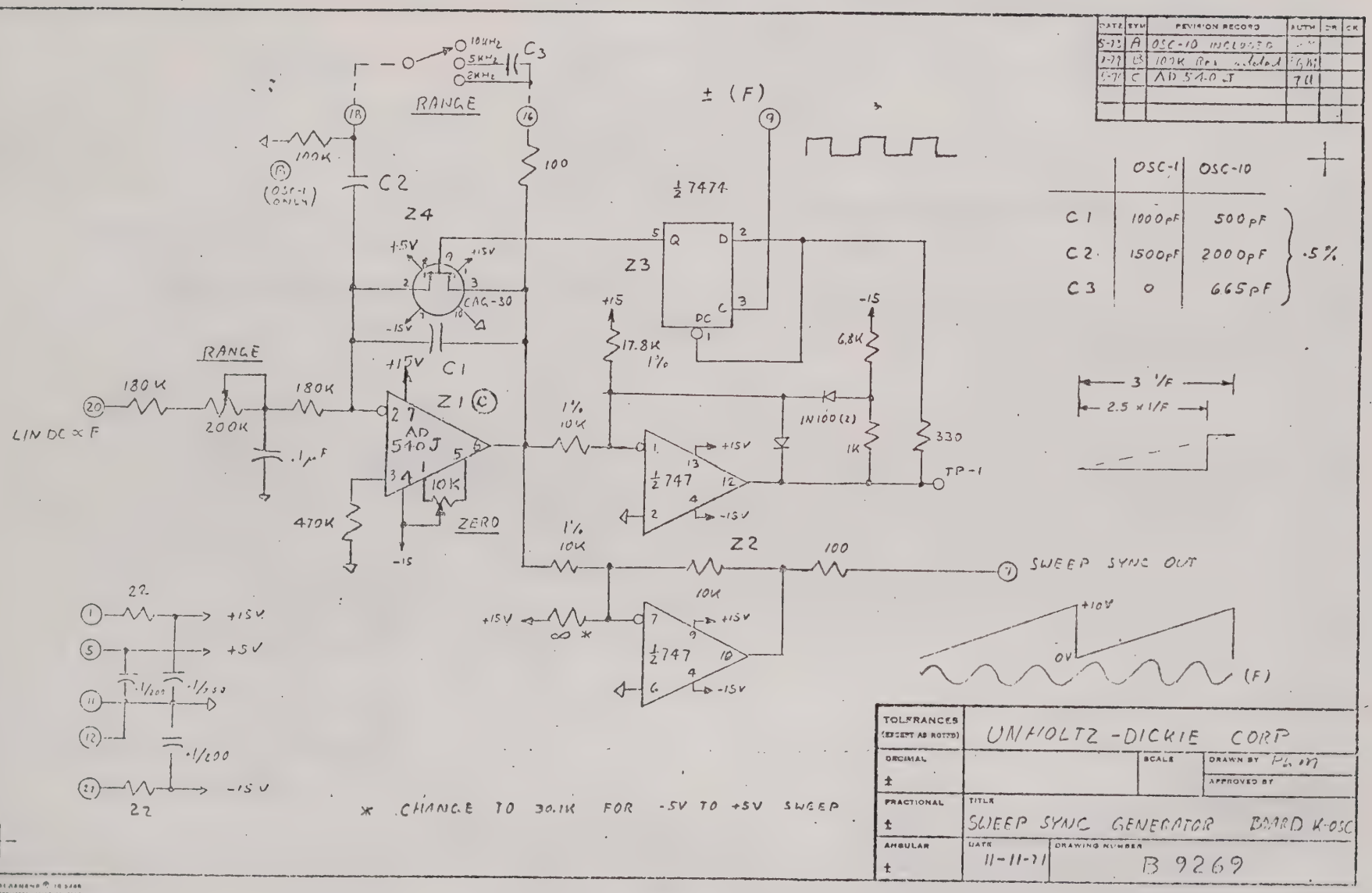
VTL 2C2 - MATCHED SET

TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ-DICKIE CORP.		
DECIMAL ±	OSC-1 OSP-4	SCALE	DRAWN BY TU / APPROVED BY
FRACTIONAL ±	TITLE COMPONENT LAYOUT N-OSC TRACKING LO-PASS		
ANGULAR ±	DATE 5-16-75	DRAWING NUMBER A9322	

F16 7.22

CRYSTALENE ® 10 5465

MADE IN U.S.A.



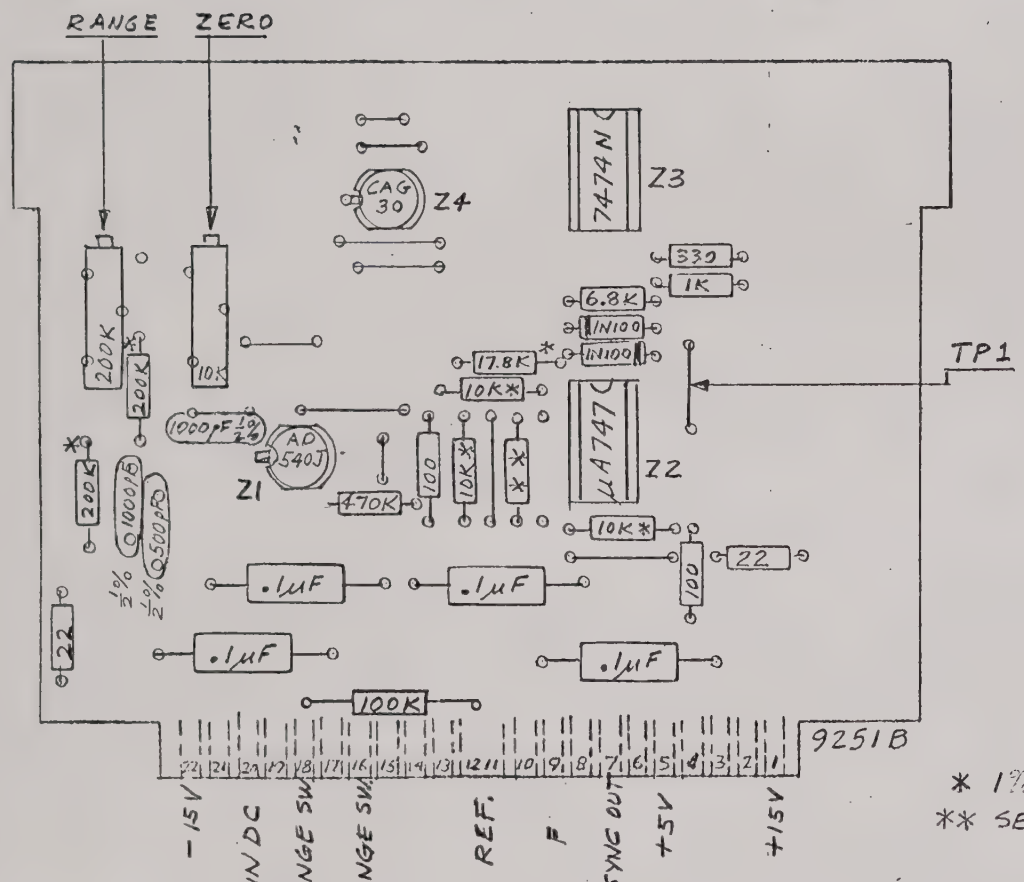
DATE	SYM	REVISION RECORD	AUTH	DR	CK
5-73	A	OSC-10 INCLUDED			
1-74	B	100K Pot added	FGH		
6-74	C	AD 540 J	TH		

	OSC-1	OSC-10	
C1	1000pF	500pF	±5%
C2	1500pF	2000pF	
C3	0	665pF	

TOLERANCES (EXCEPT AS NOTED)	UNIHOLTZ-DICKIE CORP		
DECIMAL ±		SCALE	DRAWN BY PL m
			APPROVED BY
FRACTIONAL ±	TITLE SWEEP SYNC GENERATOR BOARD W-OSC		
ANGULAR ±	DATE 11-11-71	DRAWING NUMBER B 9269	

Fig 7.23

DATE	SYM	REVISION RECORD	AU	R.	CK.
5-75	A	BOARD SIZE CHGD	T		
		AD540J ADDED			



* 1% METAL FILM
** SELECTED

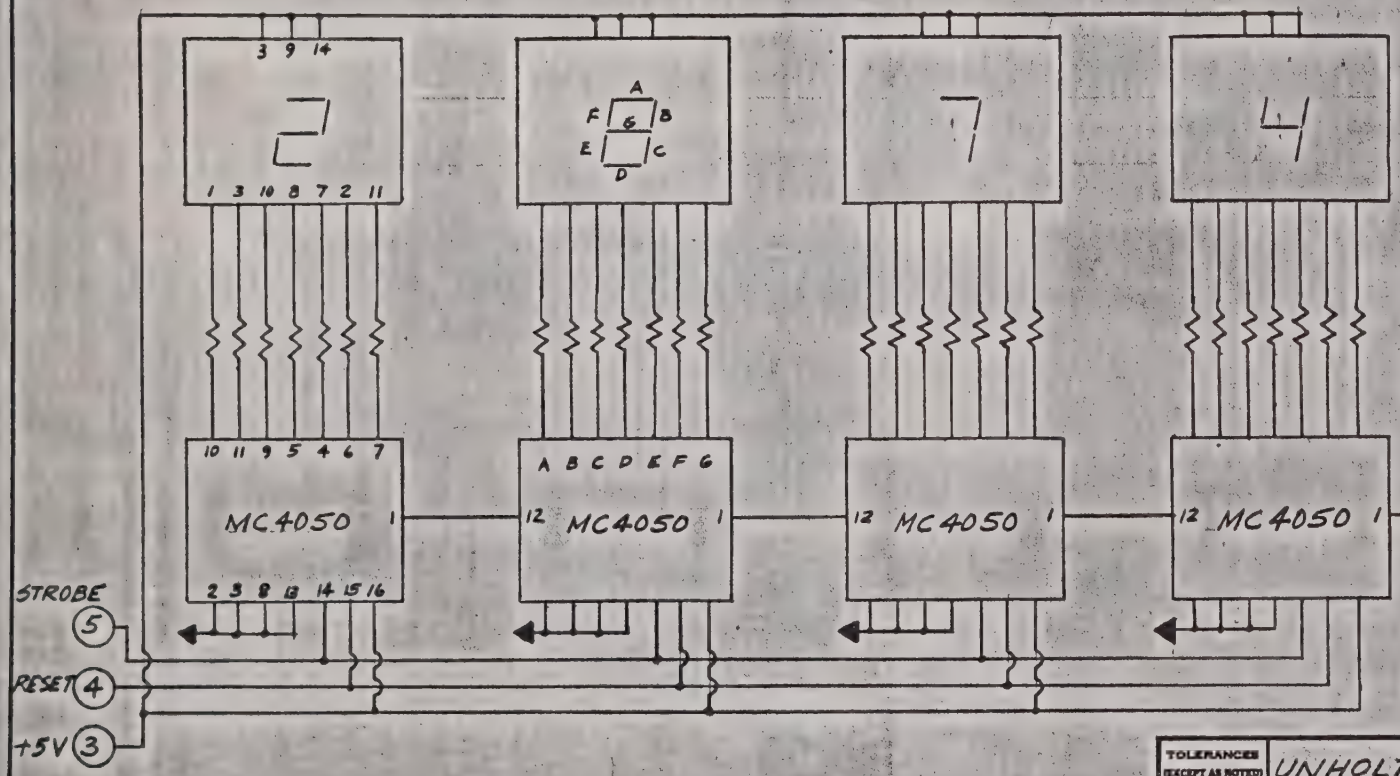
TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ-DICKIE CORP.		
DECIMAL ±	OSC-1 OSP-4	SCALE	DRAWN BY TU APPROVED BY
FRACTIONAL ±	TITLE COMPONENT LAYOUT K-OSC SWEEP SYNC GENERATOR		
ANGULAR ±	DATE 5-16-75	DRAWING NUMBER A9265	

FIG 7.24

CRYSTALENE © 10 5465

MADE IN U.S.A.

DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.



HEWLETT PACKARD
5082-

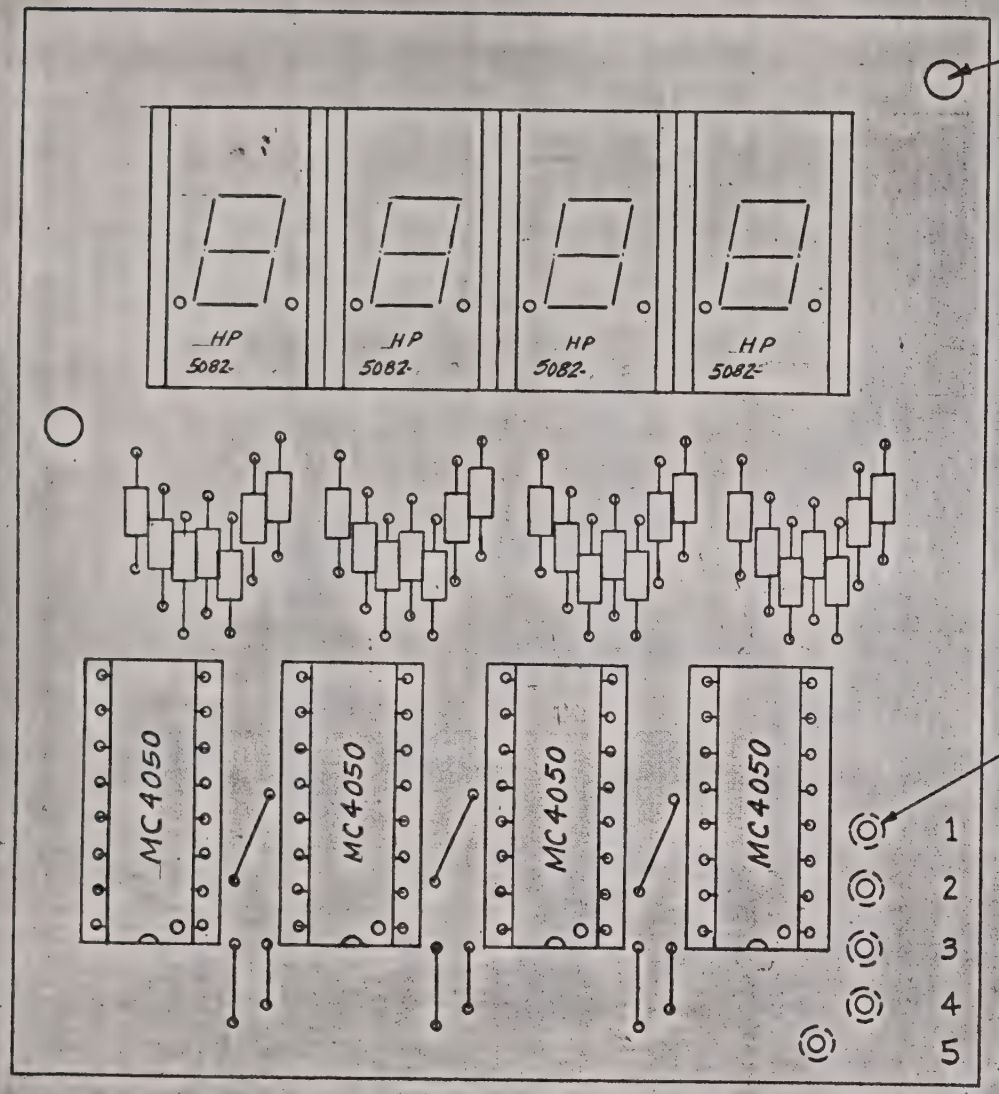
ALL RESISTORS
Ω 1/8 W

L-OSC

TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ-DICKIE CORP.		
DECIMAL ± —		SCALE —	DRAWN BY TU APPROVED BY
FRACTIONAL ±	TITLE DISPLAY COUNTER CARD 13801		
ANGULAR ±	DATE 2-21-75	DRAWING NUMBER B13803	

FIG 7.25

K·E

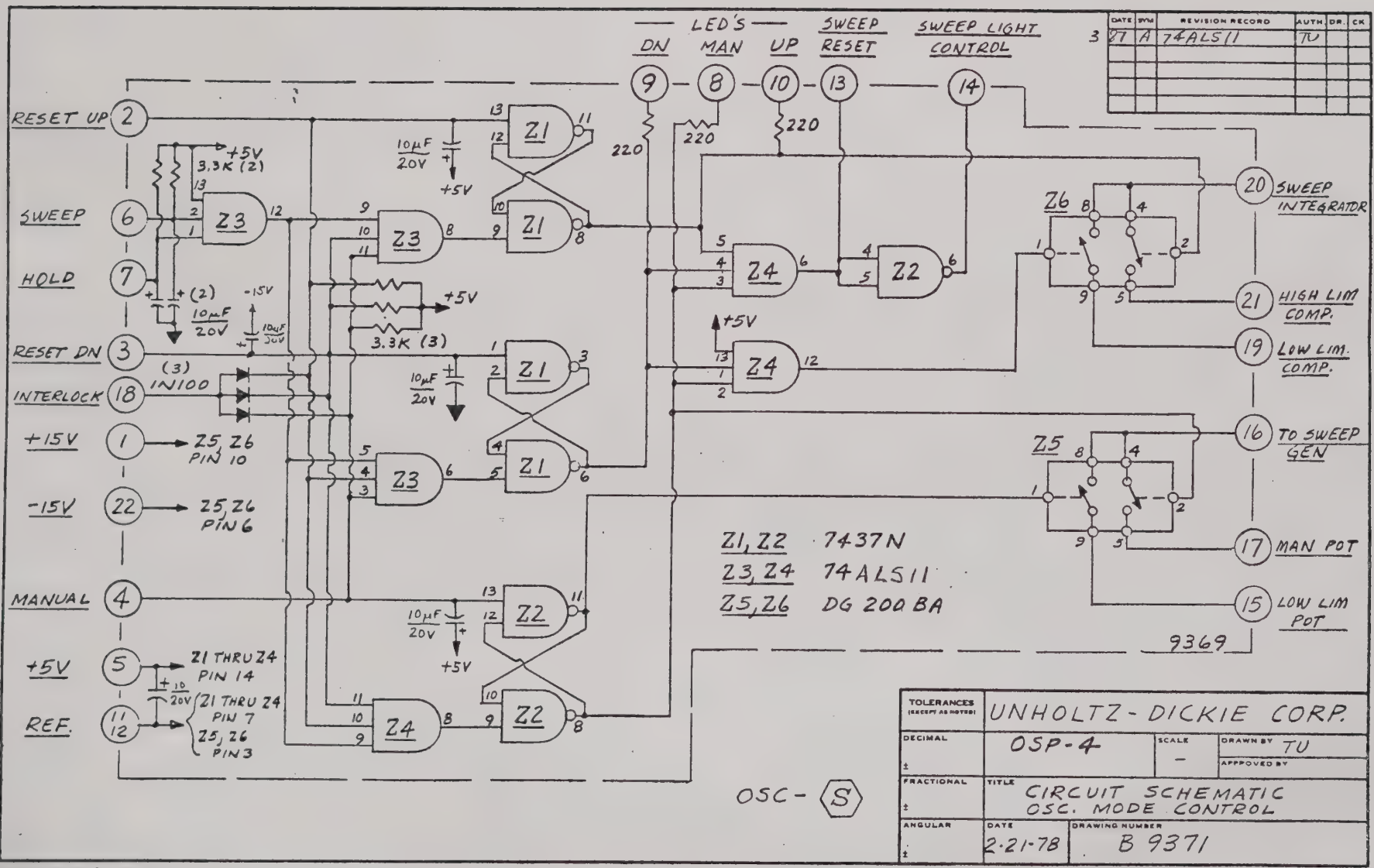


ALL RESISTORS Ω 1/8 W 10%

L-OSC

TOLERANCES EXCEPT AS NOTED	UNHOLTZ-DICKIE CORP
DECIMAL ±	OSP-4
SCALE	
DRAWN BY TU	
APPROVED BY	
FRACTIONAL ±	TITLE DISPLAY COUNTER COMPONENT LAYOUT
ANGULAR ±	DATE 2-21-75
DRAWING NUMBER	C13802

FIG 726



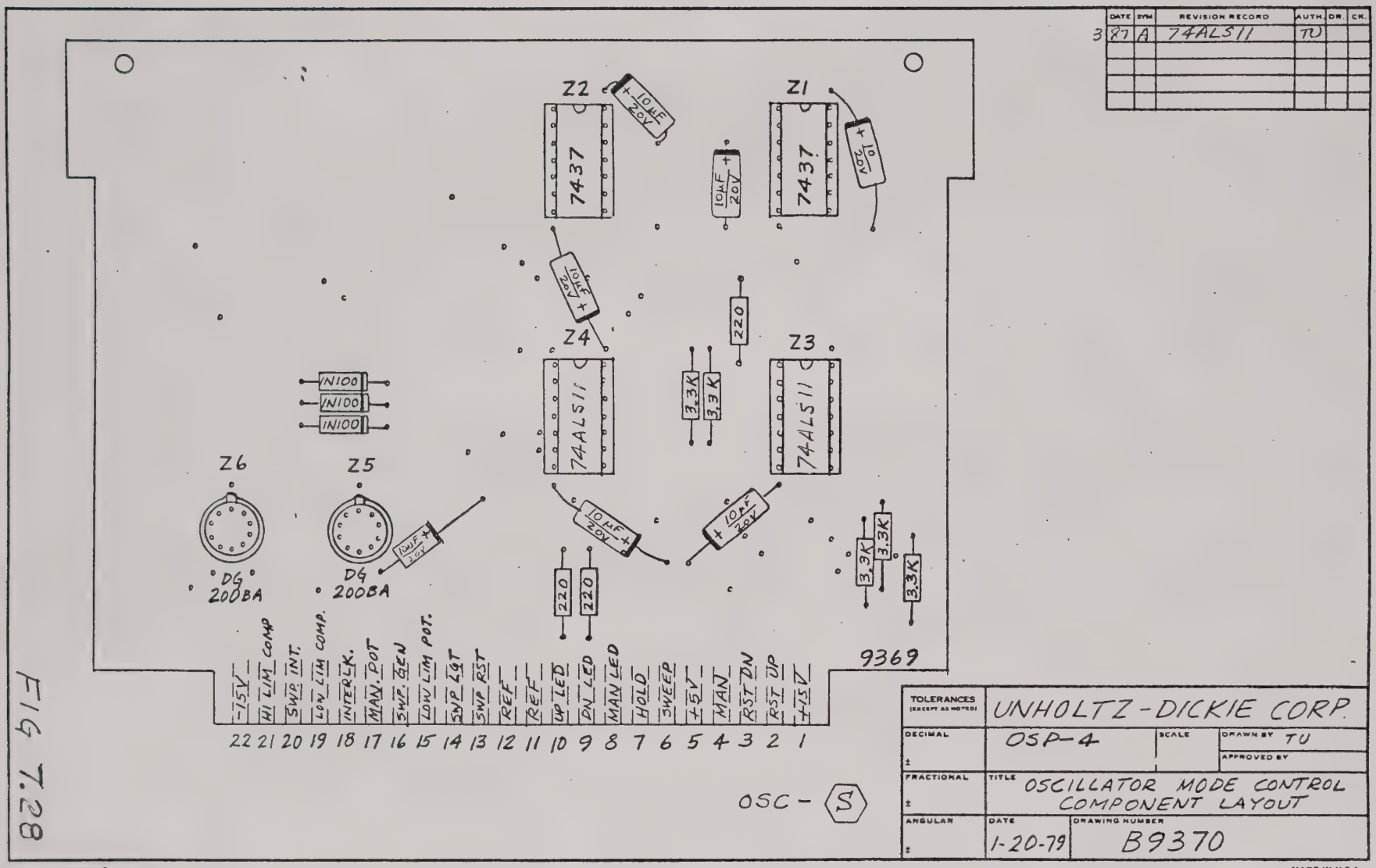
DATE	SYM	REVISION RECORD	AUTH.	DR.	CK
3 77	A	74ALS11	TU		

TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ-DICKIE CORP.		
DECIMAL ±	OSP-4	SCALE -	DRAWN BY TU; APPROVED BY
FRACTIONAL ±	TITLE CIRCUIT SCHEMATIC OSC. MODE CONTROL		
ANGULAR ±	DATE 2-21-78	DRAWING NUMBER B 9371	

FIG 7.27

K·E ALBANENE © 10 5488 ENGINEERS' STANDARD FORM

MADE IN U.S.A.



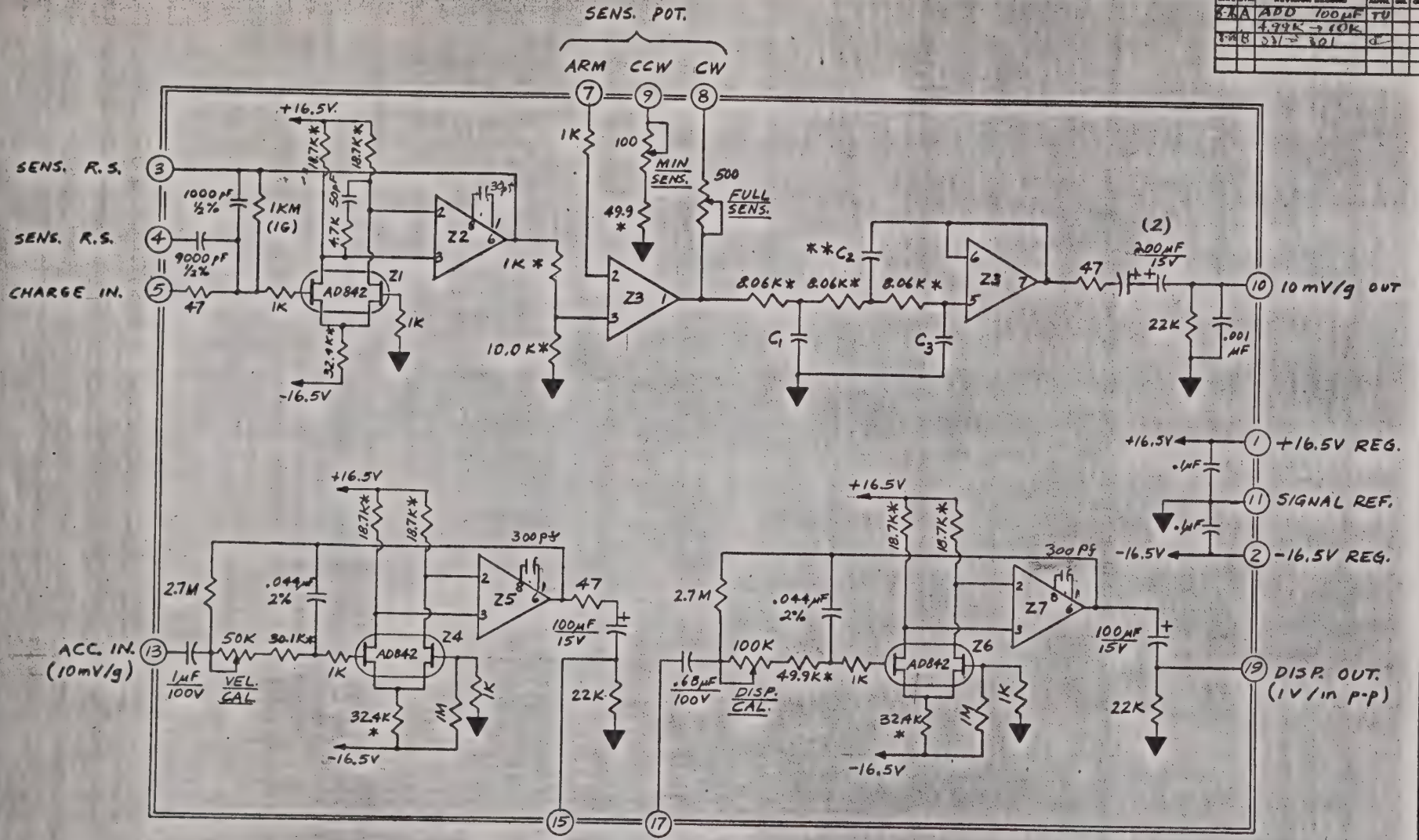
DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.
3/87	A	74ALS11	TU		

TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ-DICKIE CORP.		
DECIMAL ±	OSP-4	SCALE	DRAWN BY TU
			APPROVED BY
FRACTIONAL ±	TITLE OSCILLATOR MODE CONTROL COMPONENT LAYOUT		
ANGULAR ±	DATE 1-20-79	DRAWING NUMBER B9370	

F19 728

K·E ALBANENE © 10 5468 ENGINEERS' STANDARD FORM

MADE IN U.S.A.



	REVISION RECORD	APPR.
8-74 A	ADD 100μF	TU
1-75 B	4.99K → 10K	
	22 → 301	

FIG 7.29

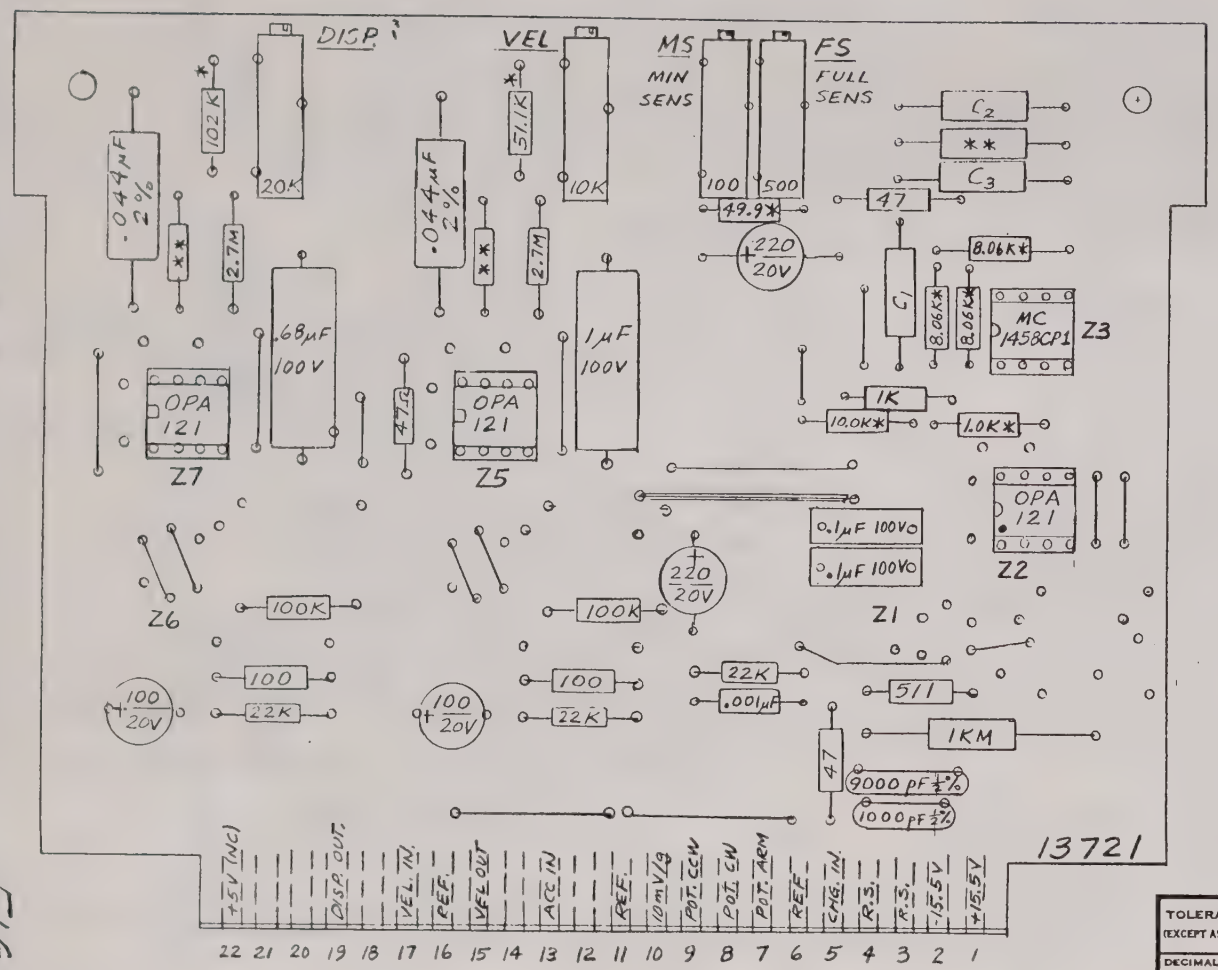
* 1% METAL FILM
** SHUNTED

	2kHz	3kHz	4kHz	5kHz	10kHz
C_1	.0068	.004[illegible]	.0033	.0027	.0012
C_2	.015	.0[illegible]	.0068	.005	.003

IC	TYPE	PIN +16.5V	PIN -16.5V
Z2,5,7	LM301	7	4
Z3	MC1458CP1	8	4

TOLERANCES EXCEPT AS NOTED	UNHOLTZ-DICKIE CORP.
DECIMAL ±	MOD. SPA-7 MOD. OSP-4
FRACTIONAL	TITLE CIRCUIT, SCALE – DRAWN BY TU APPROVED BY

A-SERVO



DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.
5-15	A	ADDED 3-POLE FIL-	TU		
9-86	B	CHGD CIRCUIT	TU		

SHUNTED *

	2kHz	3kHz	4kHz	5kHz	10kHz
C1	.0068	.0047	.0033	.0027	.0012
C2	.015	.01	.0068	.005	.003
C3	.001	680pF	500pF	390pF	220pF

** FACTORY SELECTED

* 1% METAL FILM

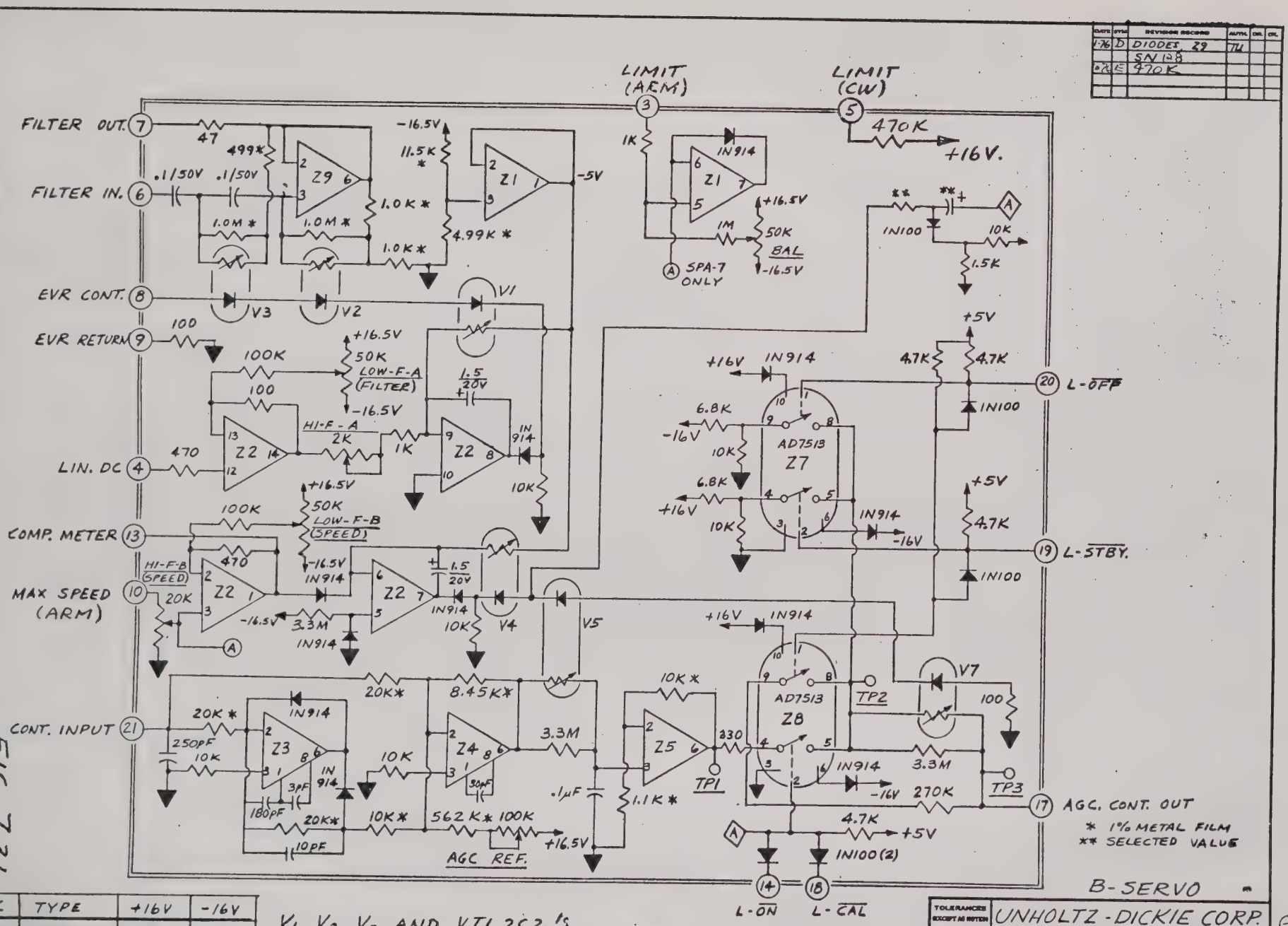
SERVO

A

TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ-DICKIE CORP.		
DECIMAL ±	UD340 OSP-4 SPA-7	SCALE	DRAWN BY TU APPROVED BY
FRACTIONAL ±	TITLE COMPONENT LAYOUT CHG. AMP. - DAG - VEL & DISP INT.		
ANGULAR ±	DATE 12-18-86	DRAWING NUMBER B13722-B	

FIG. 7.30

ALBANENE ® 10 5487
MADE IN U.S.A.



IC	TYPE	+16V	-16V
Z1	MC1458CP1	8	4
Z2	MC3303P	4	11

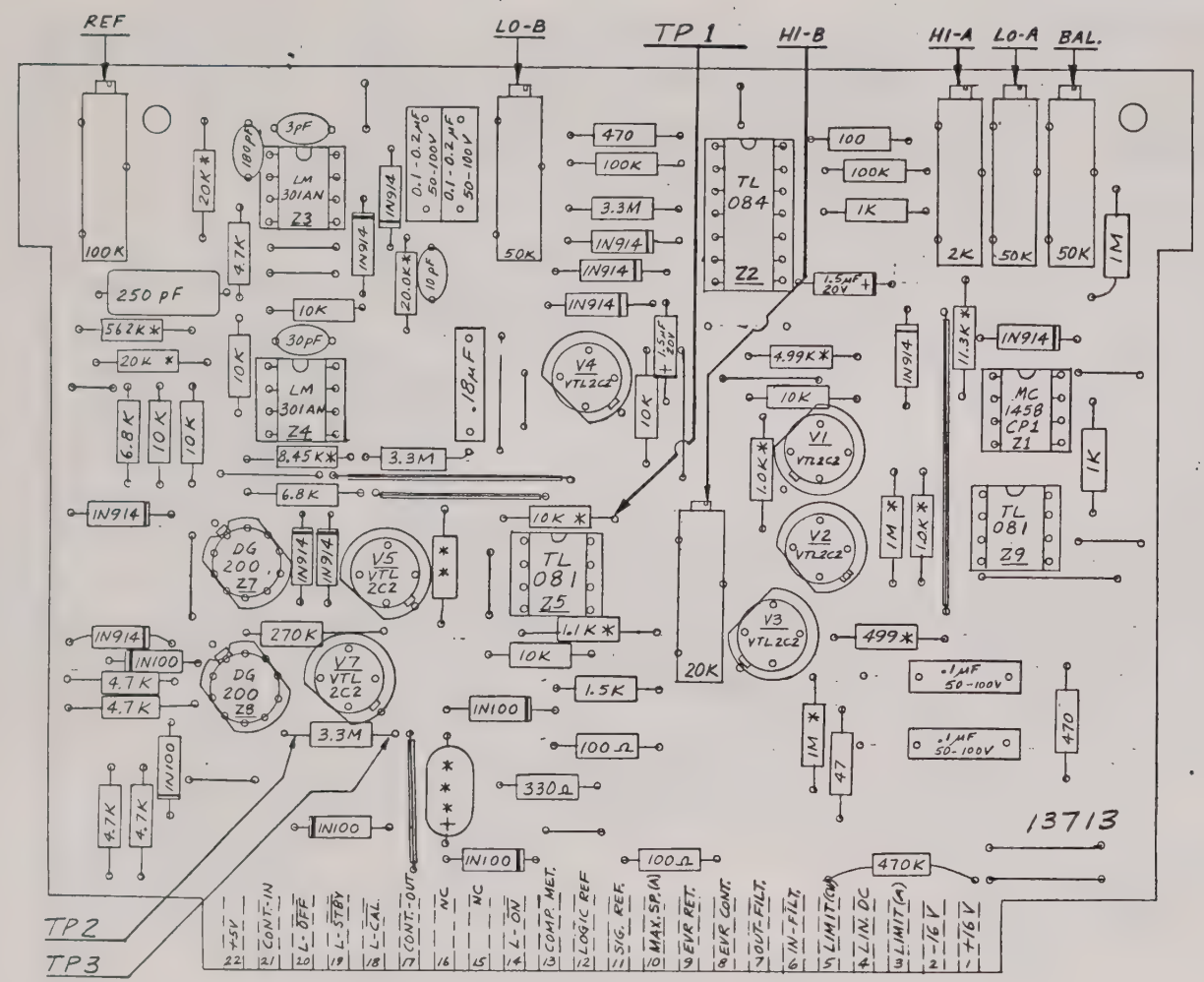
V1, V2, V3 AND VTL2C2 'S ON SW-1 THRU 4 MATCHED (**)

DATE	BY	REVISION RECORD	APPVD.	DR.	CK.
1-76	D	DIODES Z9	TU		
		SN 128			
8-76	E	470K			

TOLERANCES EXCEPT AS NOTED	UNHOLTZ-DICKIE CORP.
DECIMAL ±	MOD SPA-7 MOD. OSP-4
SCALE —	DRAWN BY TU

B-SERVO

FIG 7.31



* 1% METAL FILM

** SELECTED (15K - 47K)

*** SELECTED (10 - 100 µF)

12-16	E	OP AMPS CHGD	TU

TOLERANCES EXCEPT AS NOTED	UNHOLTZ - DICKIE CORP		
DECIMAL	SPA-7	SCALE	DRAWN BY TU
1	OSP-4 vD340		CHECKED BY
FRACTIONAL	TITLE COMPONENT LAYOUT AGC CONTROL CARD		
1			
ANGULAR	DATE	DRAWING NUMBER D13714-C	
1			

FIG. 7.32

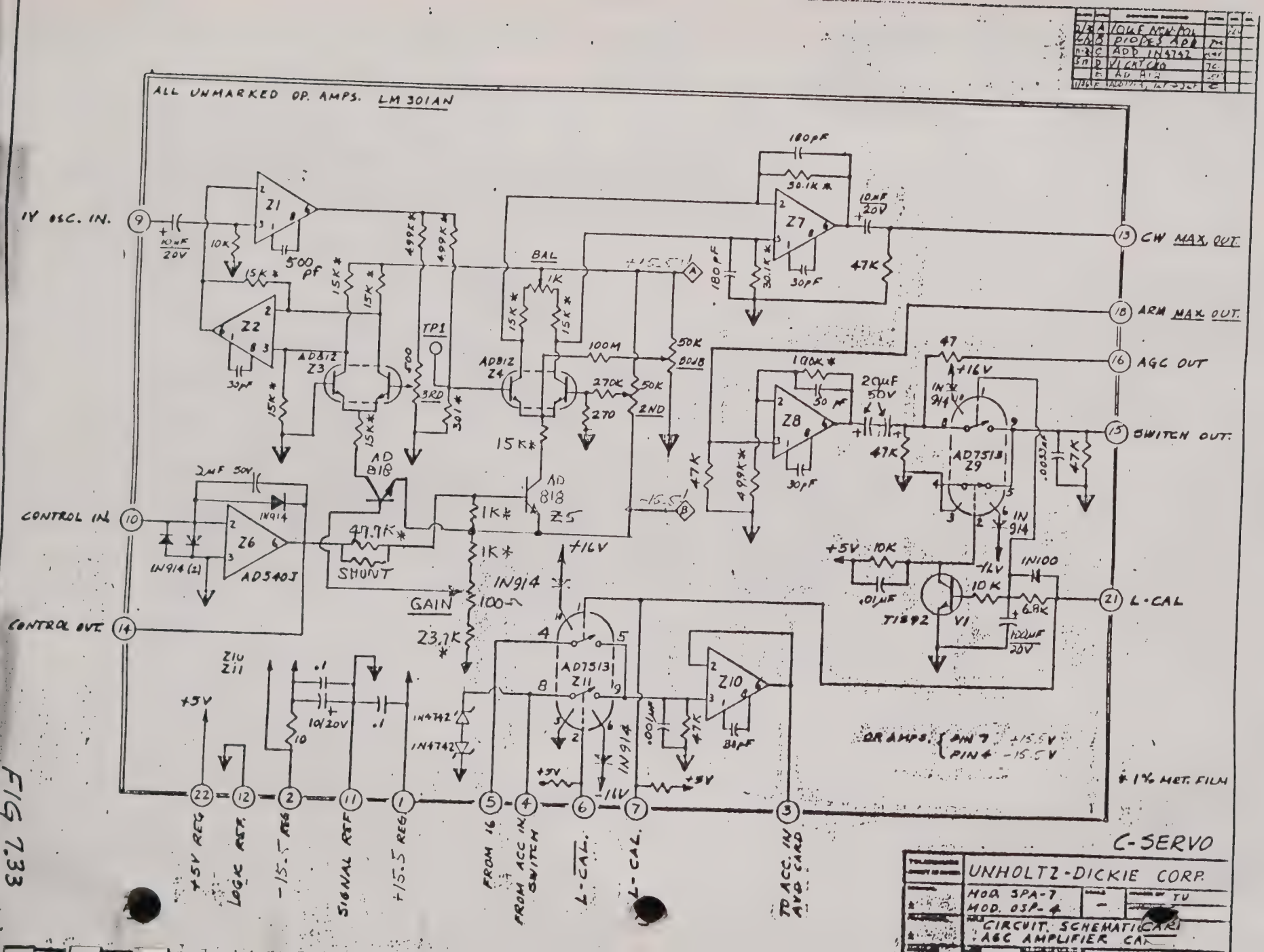
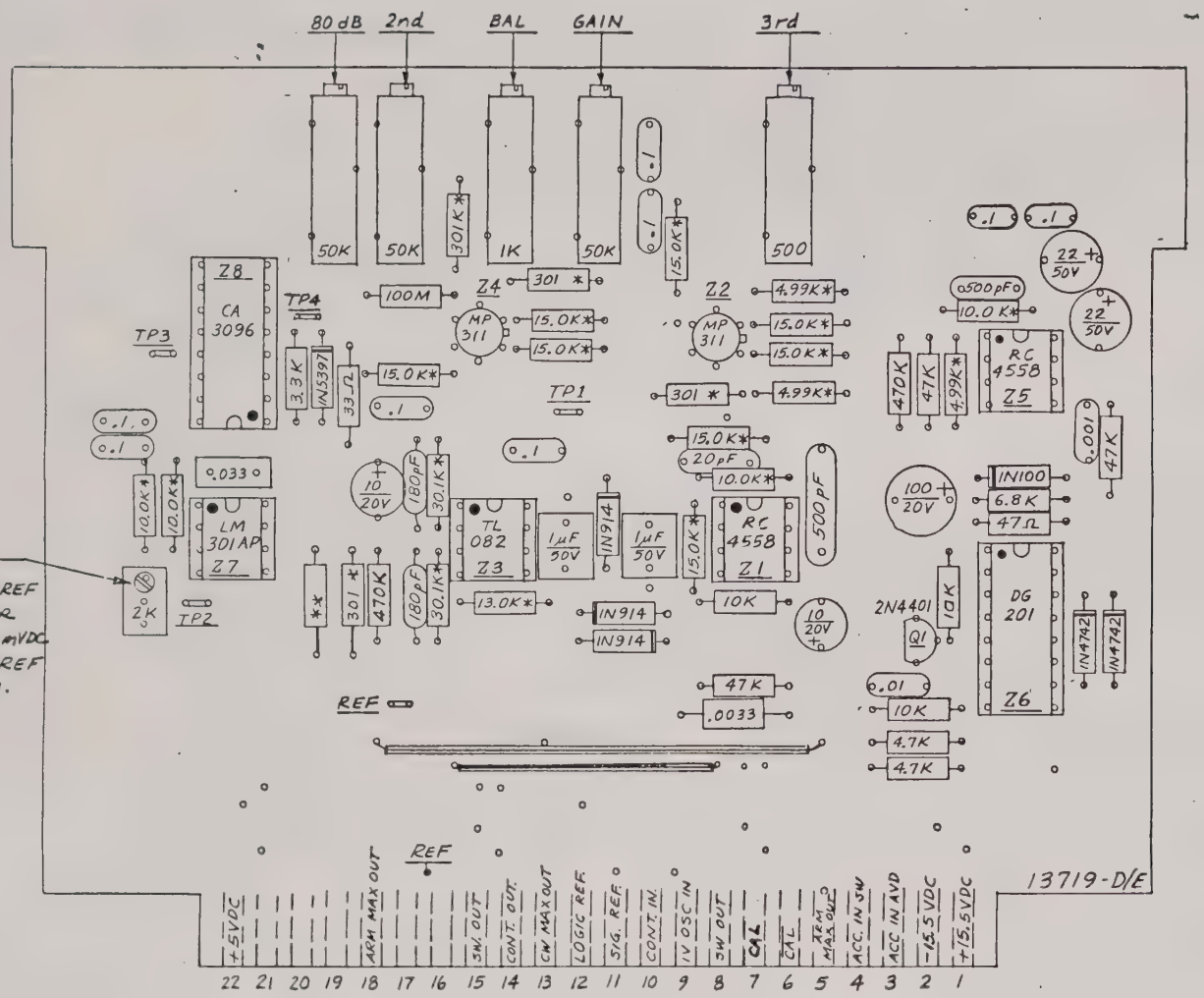

ALL UNMARKED OP. AMPS. LM 301AN
IV OSC. IN.
CONTROL IN
CONTROL OUT
CW MAX. OUT
ARM MAX. OUT
AGC OUT
SWITCH OUT
L-CAL
Z1
Z2
Z3
Z4
Z5
Z6
Z7
Z8
Z9
Z10
Z11
AD812
AD818
AD7513
AD540J
IN914
IN4742
IN100
TIP92
BAL
TP1
GAIN
SHUNT
+16V
+5V
-16V
+15.5V
-15.5V
OP AMPS: PIN 7 +15.5V
PIN 4 -15.5V
+1% MET. FILM
+5V REG
LOGIC RET.
-15.5 REG
SIGNAL RET
+15.5 REG
FROM 16
FROM ACC IN SWITCH
L-CAL.
L-CAL.
TO ACC. IN AUD. CARD
C-SERVO
UNHOLTZ-DICKIE CORP.
MOD. SPA-7
MOD. OSP-4
CIRCUIT SCHEMATIC CARD
AGC AMPLIFIER CARD

FIG 7.33



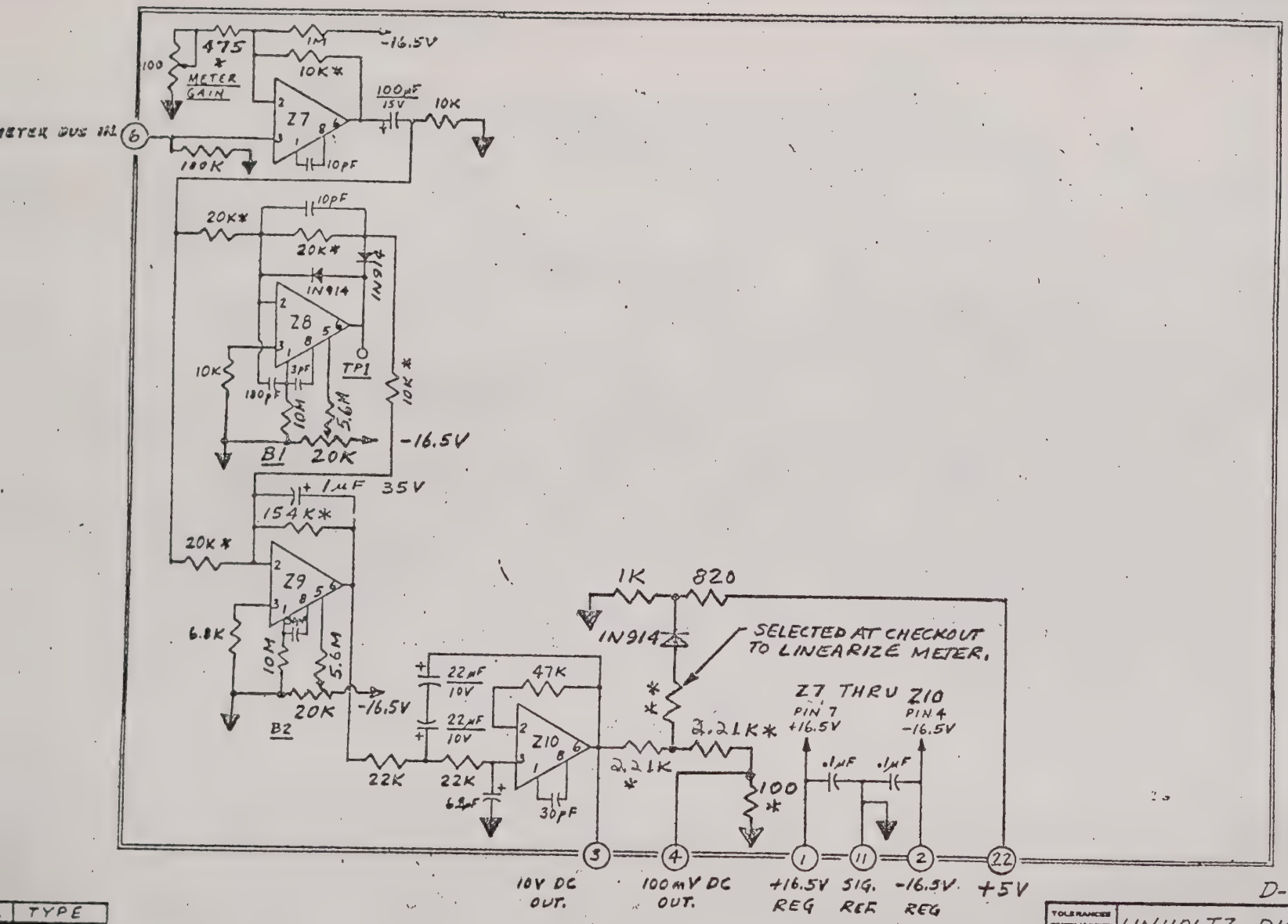
* 1% METAL FILM
** DETERMINED AT CHECKOUT

SERVO- C

UNHOLTZ-DICKIE CORP.		
OSP-4	DRAWN BY TU	
COMPONENT LAYOUT AGC AMPLIFIER		
10-2-86	B13720 D	

FIG. 7.34

DATE	STM	REVISION RECORD	AUTH	APP	CK
6/71	A	1.05K → 975	TU		
	B	CO2R 100K	TU		
5/74	C	SN122	TU		
7/71	D	4.02K → 3.32K	T		



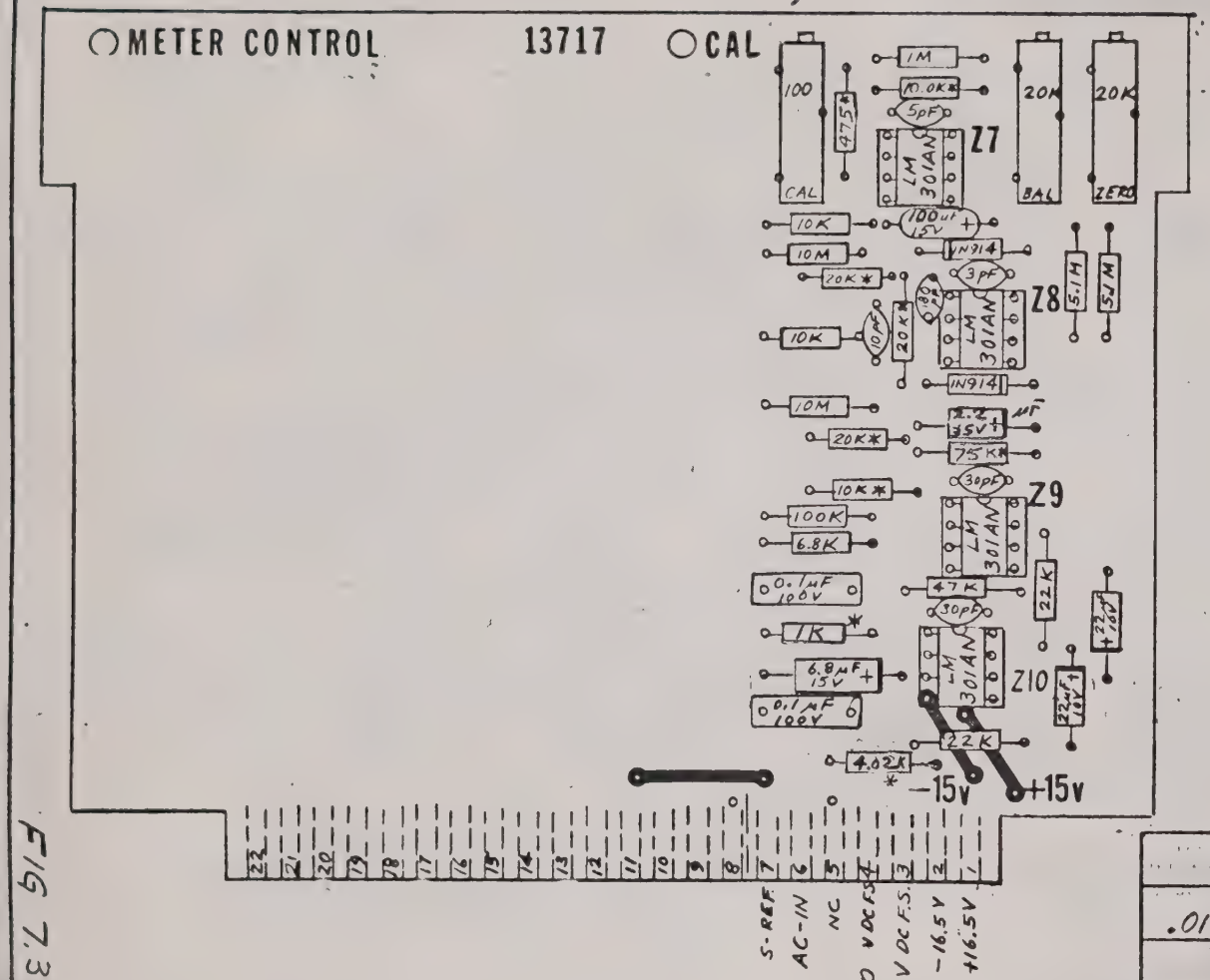
* 1% METAL FILM

	TYPE
	LM324N
	LM339N
	7404N
	7400N

D-SERVO

TOLERANCES EXCEPT AS NOTED	UNHOLTZ-DICKIE CORP.
DECIMAL ±	MOD. 03P-4
FRACTIONAL ±	TITLE CIRCUIT SCHEMATIC METER CONTROL CARD

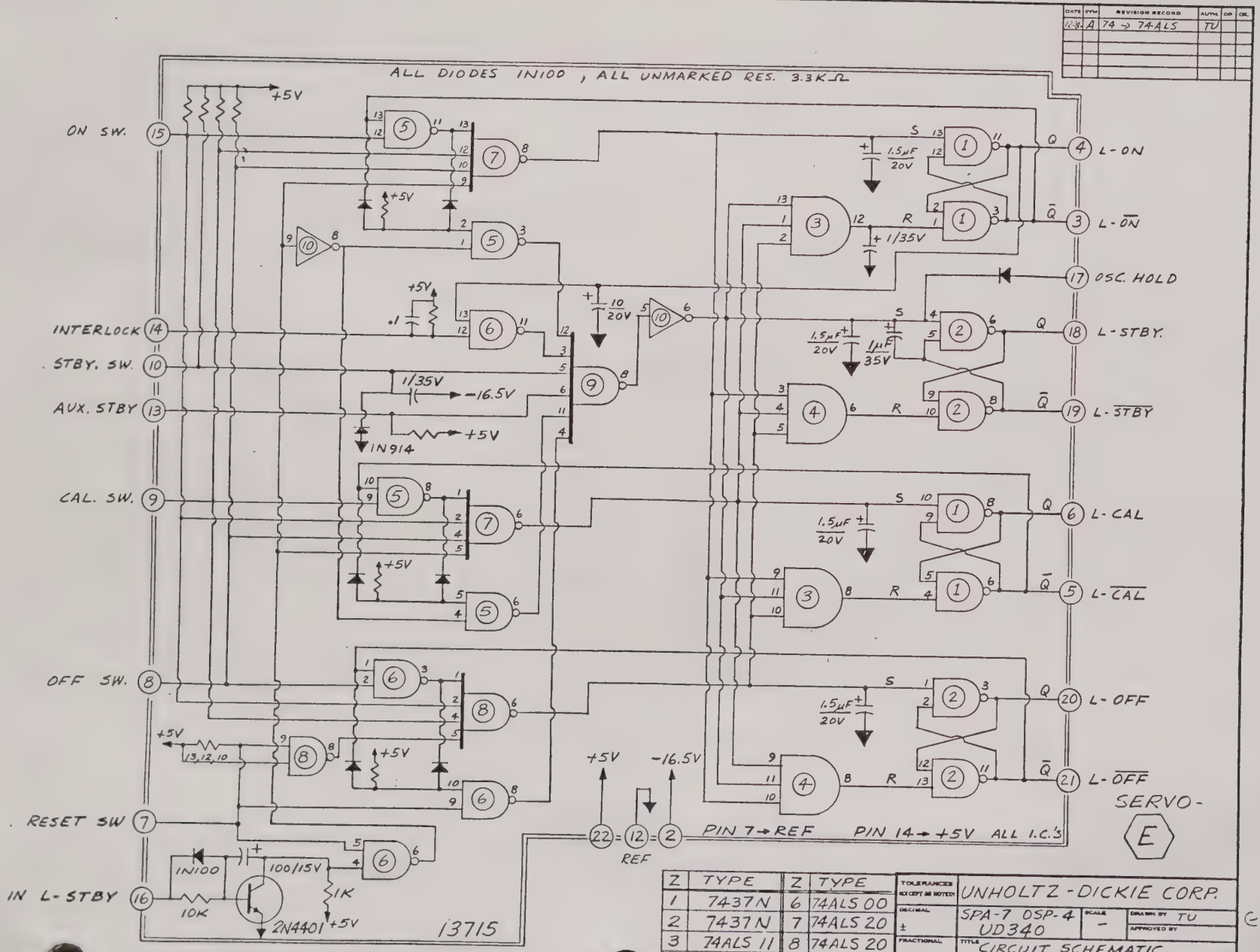
6-5	A	1.05K ⇒ 475	TU
5-76	B	SN 122	TU
7-81	C	CHG OUTPUT DIVIDER	
10-82	D	CHG GN & D-VDR	LLM



D-SERVO
** SELECTED AT CHECKOUT
* - DENOTES 1% METAL FILM

	UNHOLTZ-DICKIE CORP	
.01	MOD. OSP-4	TU
	COMPONENT LAYOUT METER AMP. - RANGE CONTROL	
	12-5-74	B13718

FIG 7.36



DATE	SYM	REVISION RECORD	AUTH	DR	CK
12-86	A	74 → 74ALS	TU		

Z	TYPE	Z	TYPE
1	7437N	6	74ALS 00
2	7437N	7	74ALS 20
3	74ALS 11	8	74ALS 20
4	74ALS 11	9	74ALS 30
5	74ALS 00	10	74ALS 04

TOLERANCES (EXCEPT AS NOTED): DECIMAL ± FRACTIONAL ± ANGULAR ±

UNHOLTZ-DICKIE CORP.

SPA-7 OSP-4 UD340

SCALE: -

DRAWN BY: TU

APPROVED BY:

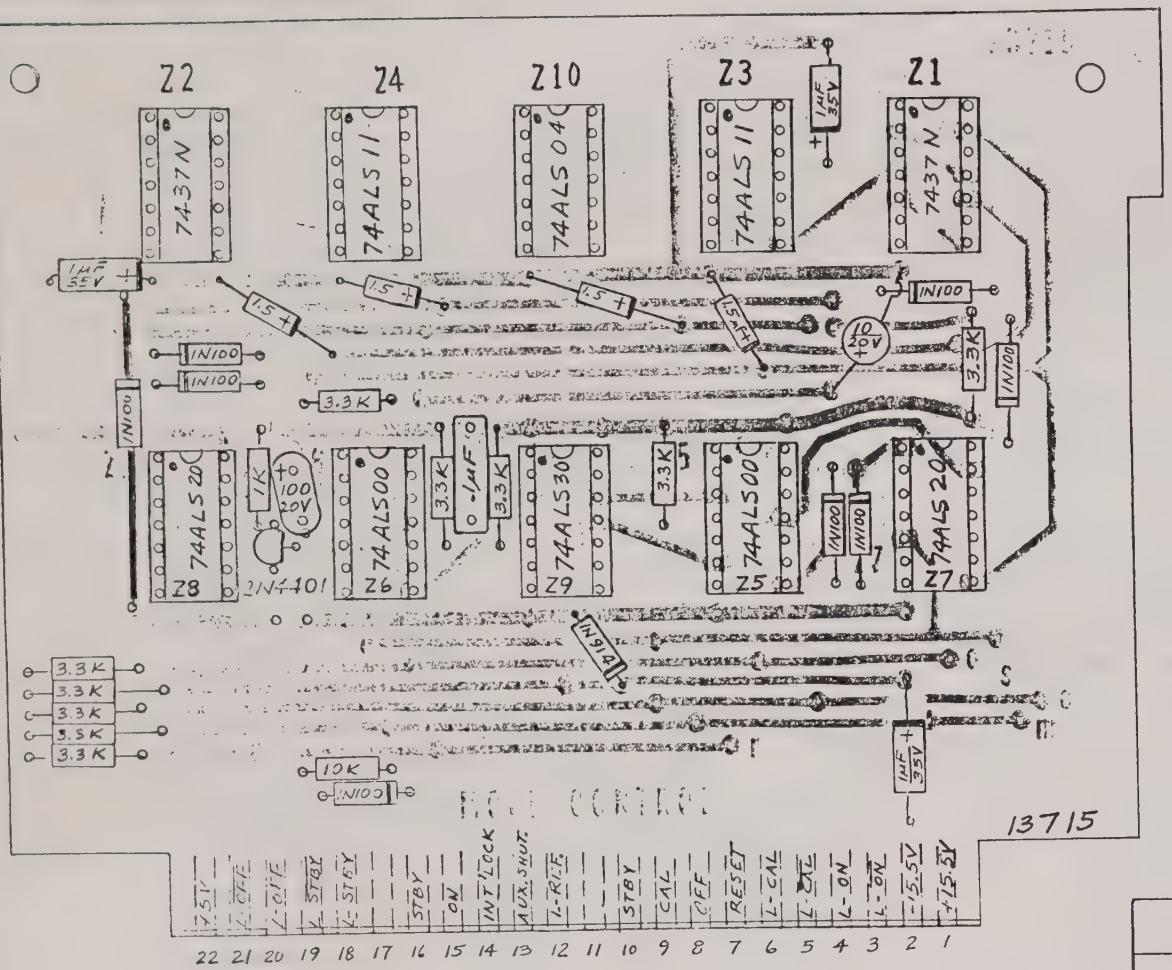
TITLE: CIRCUIT SCHEMATIC MODE CONTROL CARD

DATE: 12-20-86

DRAWING NUMBER: C13740-A

FIG. 7.37

12/86 B 74 → 74ALS TU



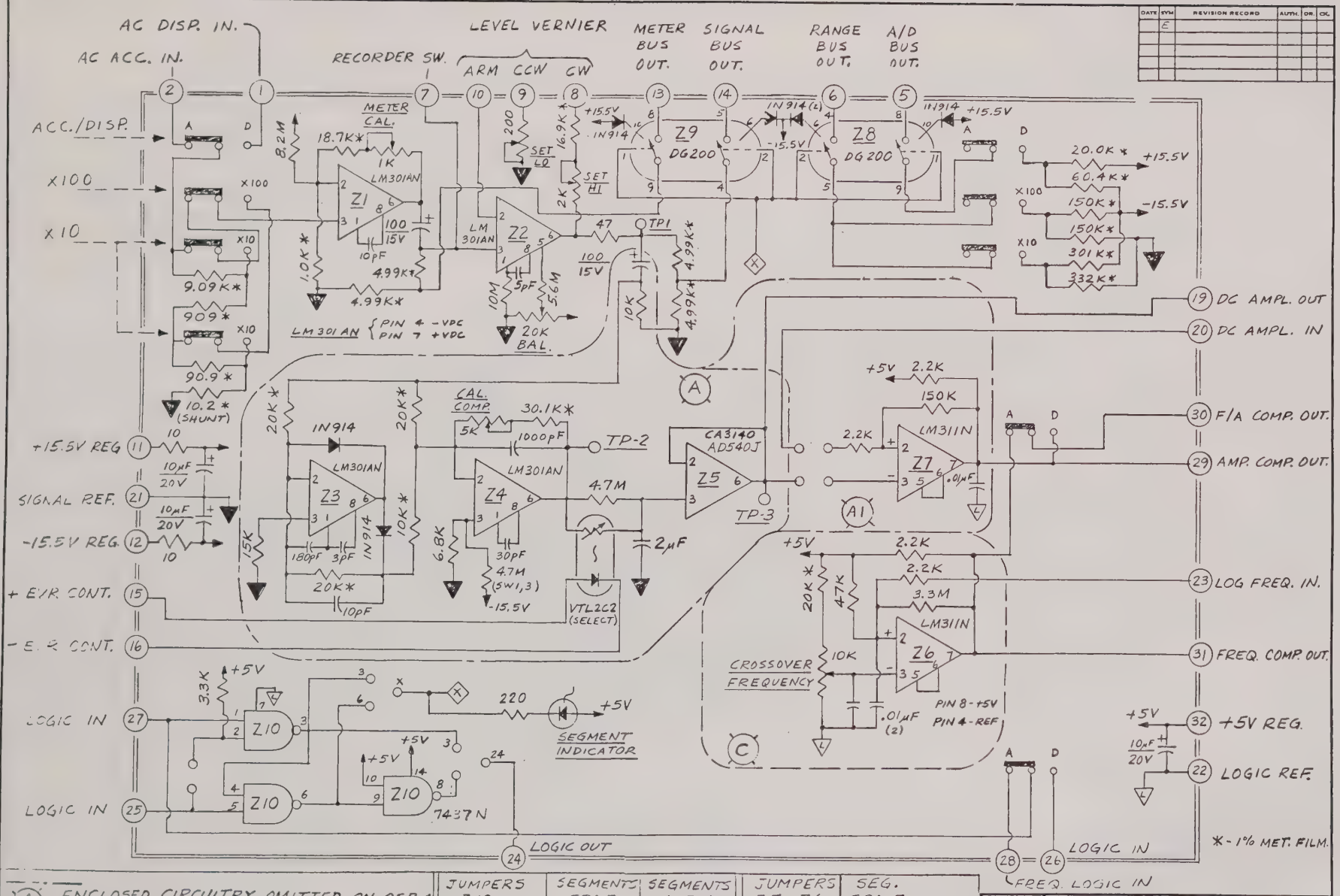
SERVO - E

SPA-7 OSP-4

COMPONENT LAYOUT

3-16-87 B13716-B

7.6.7.23



(A) ENCLOSED CIRCUITRY OMITTED ON OSP-4 & ON SEGS. 5, 6, 7 SPA-7. (A1) OMITTED ON SEG. 4, SPA-7

(C) ENCLOSED CIRCUITRY OMITTED ON SEG 4, OSP-4 & SEG. 7, SPA-7

JUMPERS Z10	SEGMENTS SPA-7	SEGMENTS OSP-4
6-X	1	1
3-X, 2-5, 8-24	2, 3, 4, 5, 6	2
3-X, 3-24	7	4

JUMPERS Z5-Z6	SEG. SPA-7
	1, 3
	2

TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ-DICKIE CORP.
DECIMAL ±	MOD. OSP-4 MOD SPA-7
SCALE —	DRAWN BY TU
FRACTIONAL ±	APPROVED BY
TITLE	CIRCUIT SCHEMATIC SWITCHING AMPLIFIER CARDS
ANGULAR ±	DATE 5-28-75
DRAWING NUMBER	C13742 L

DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.
	E				

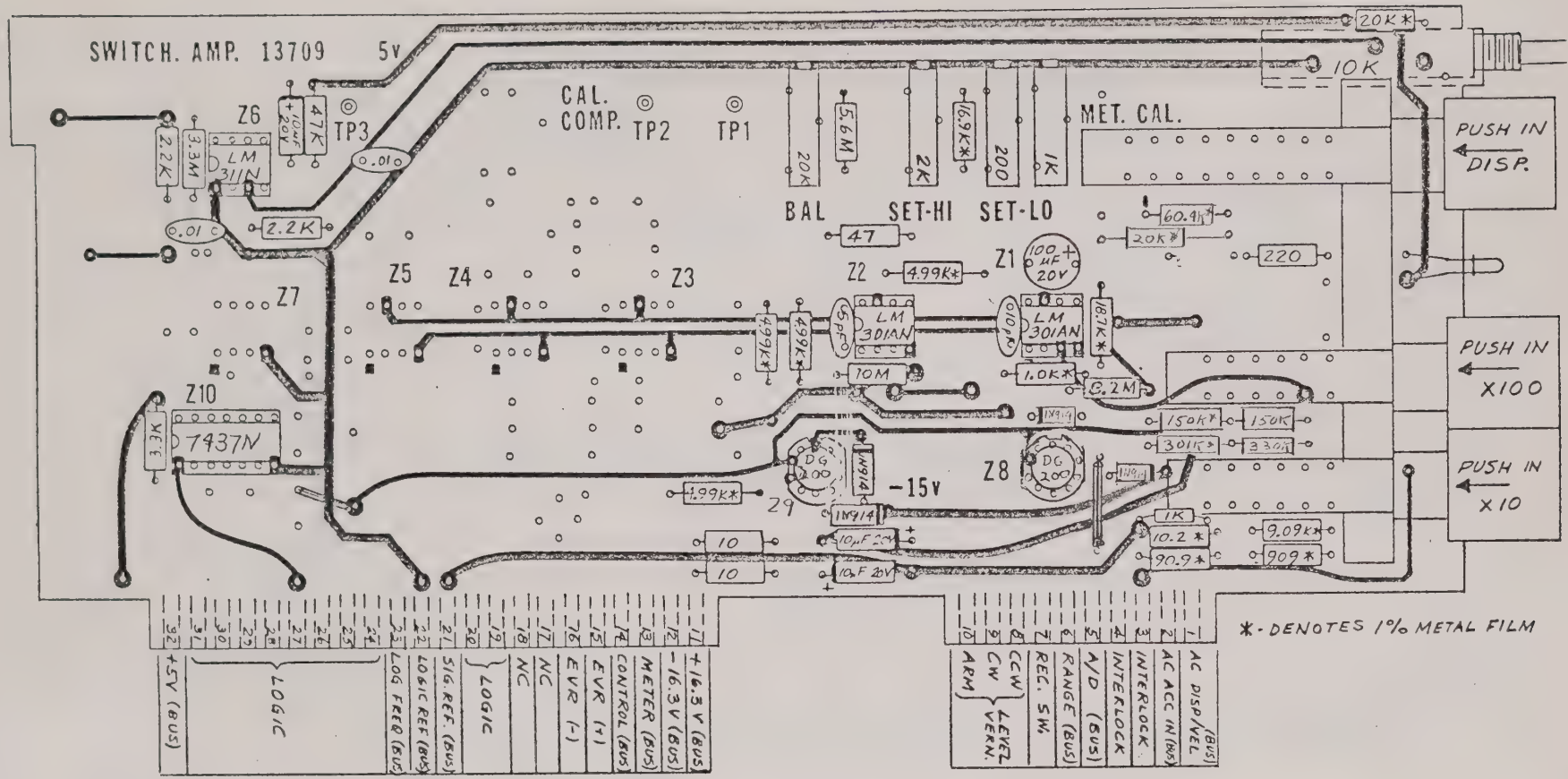
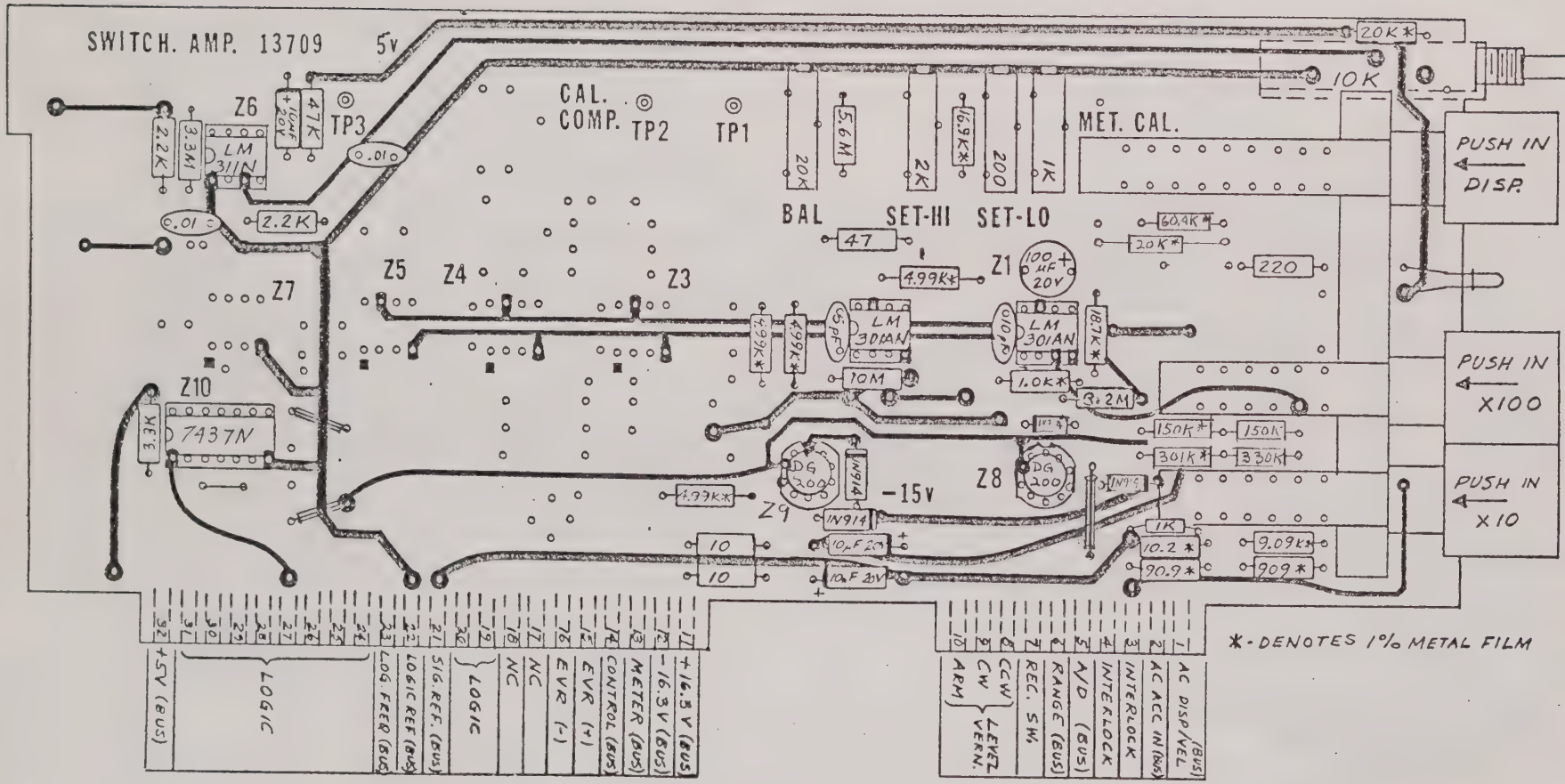


FIG 7.40

SEGMENT 1 OSP-4

TOLERANCES EXCEPT AS NOTED	U-D CORP		
DECIMAL ±		SCALE	DRAWN BY / APPROVED BY
FRACTIONAL ±	TITLE SWITCH CARD COMPONENT LAYOUT		
ANGULAR ±	DATE 1-31-76	DRAWING NUMBER C13734	

SW-1 SERVO



SEGMENT 2, 3 OSP-4

TOLERANCES EXCEPT AS NOTED	U-D CORP
DECIMAL ±	SCALE
FRACTIONAL ±	TITLE SWITCH CARD COMPONENT LAYOUT
ANGULAR ±	DATE 1-31-74 DRAWING NUMBER C-10-32

SW 3 RVC

FIG 7.41

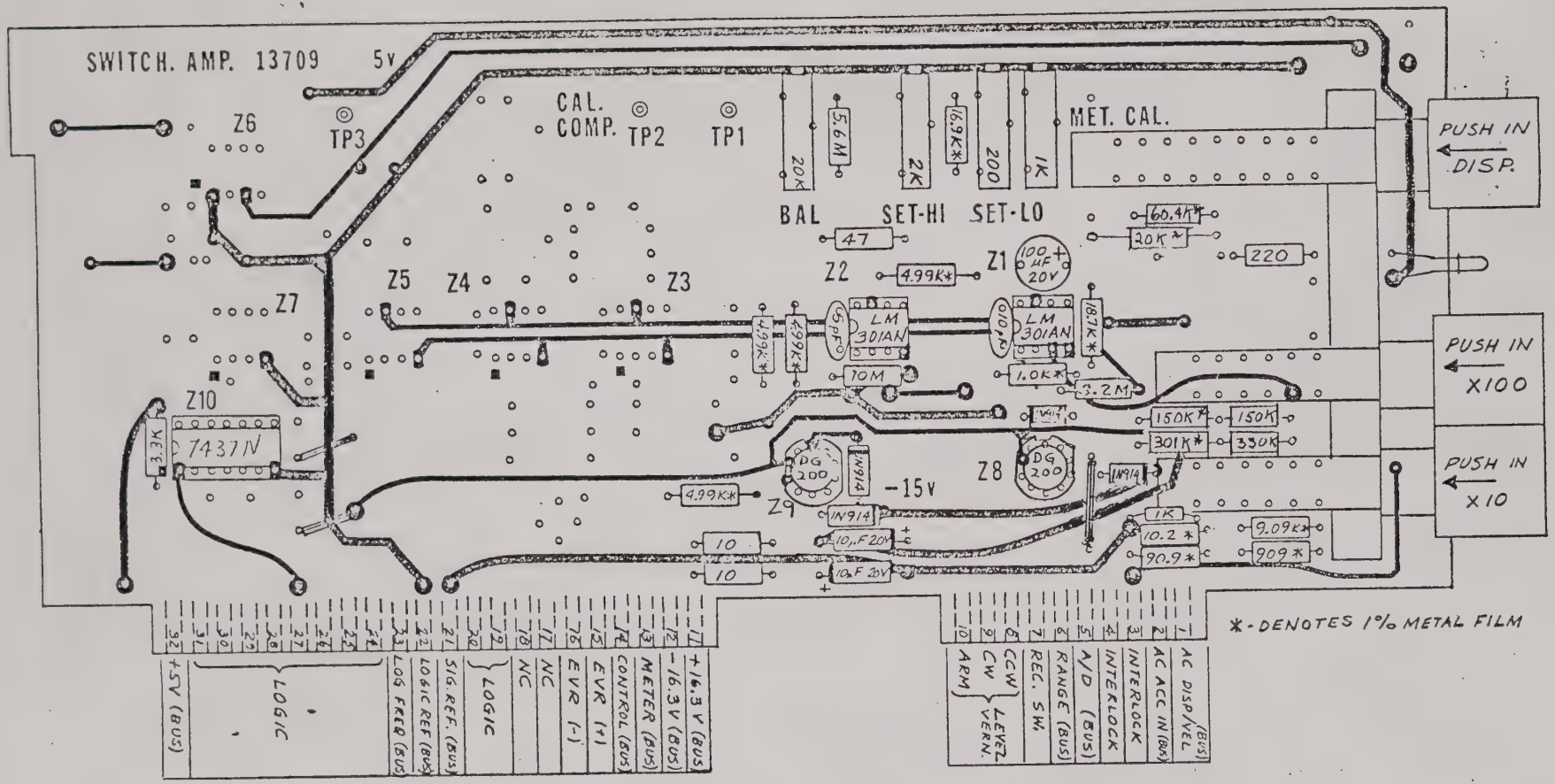
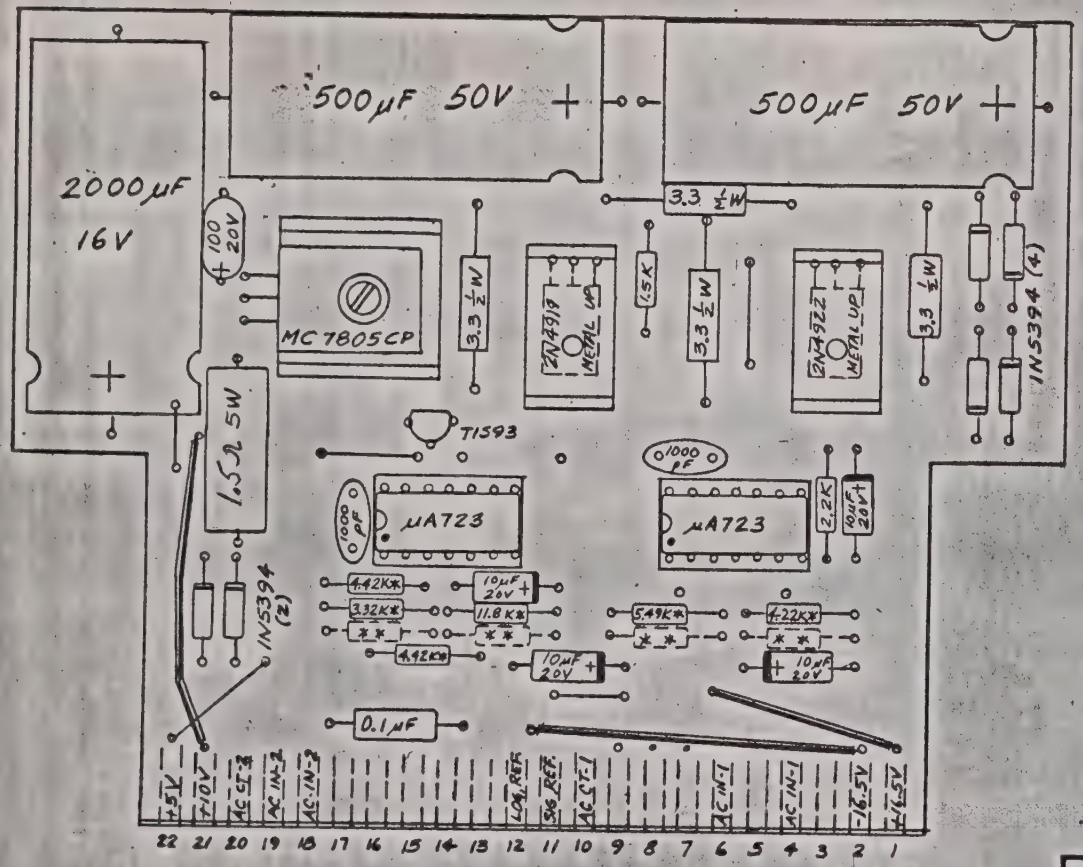


FIG 7.42

SEGMENT 4 .OSP-4

TOLERANCES EXCEPT AS NOTED	U-D CORP		
DECIMAL ±		SCALE	DRAWN BY / APPROVED BY
FRACTIONAL ±	TITLE SWITCH CARD COMPONENT LAYOUT		
ANGULAR ±	DATE 1-31-76	DRAWING NUMBER C13733	

SW-4 SERVO



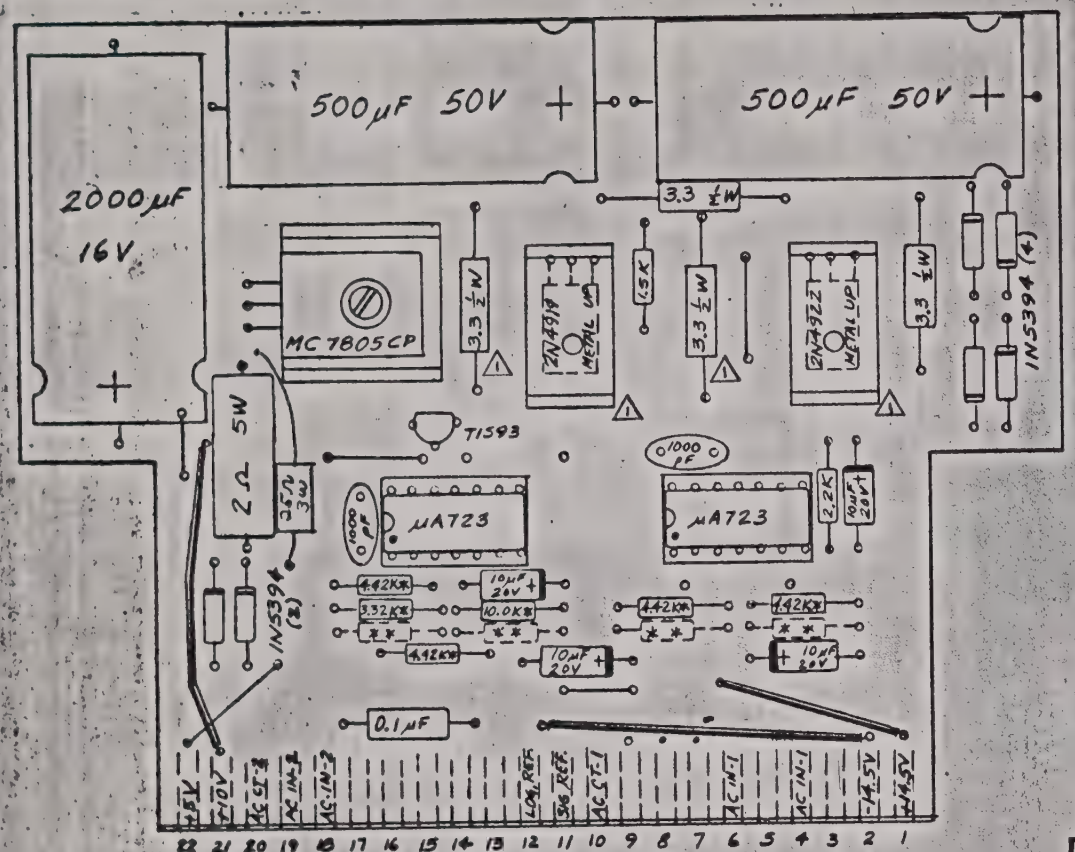
DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.

** - FACTORY SELECT
* - DENOTES 1% METAL FILM

TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ-DICKIE CORP.		
DECIMAL ±	SPA-7 OSP-4	SCALE 2X	DRAWN BY TU / APPROVED BY
FRACTIONAL ±	TITLE COMPONENT LAYOUT POWER SUPPLY CARD		
ANGULAR ±	DATE 1-5-74	DRAWING NUMBER B13724	

PS-SERVO

FIG 7.43



DATE	BY/M	REVISION RECORD	AUTH.	DR.	CK.
1-7	A	NOTE 1			

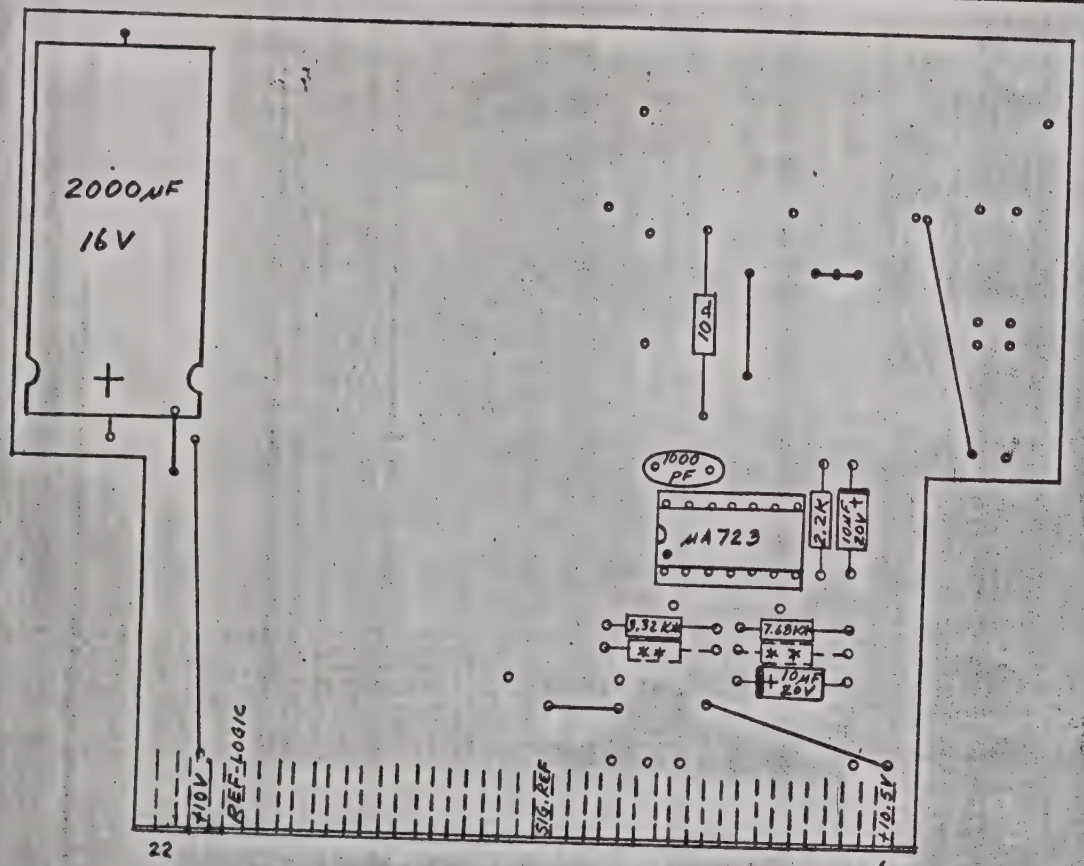
⚠1 OPTION RD (RES. DWELL & COUNTER): 3.3Ω BECOMES 2.2Ω; HEAT SINKS' SIZE INCREASED.

** - FACTORY SELECT
* - DENOTES 1% METAL FILM

TOLERANCES EXCEPT AS NOTED	UNHOLTZ-DICKIE CORP.
DECIMAL ±	SPA-7 OSP-4
SCALE	2X
DRAWN BY	TU
APPROVED BY	
FRACTIONAL ±	TITLE: COMPONENT LAYOUT POWER SUPPLY CARD
ANGULAR ±	DATE: 1-5-74
DRAWING NUMBER	B13821

PS-OSC-1

FIG 7.44



DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.

** FACTORY SELECT

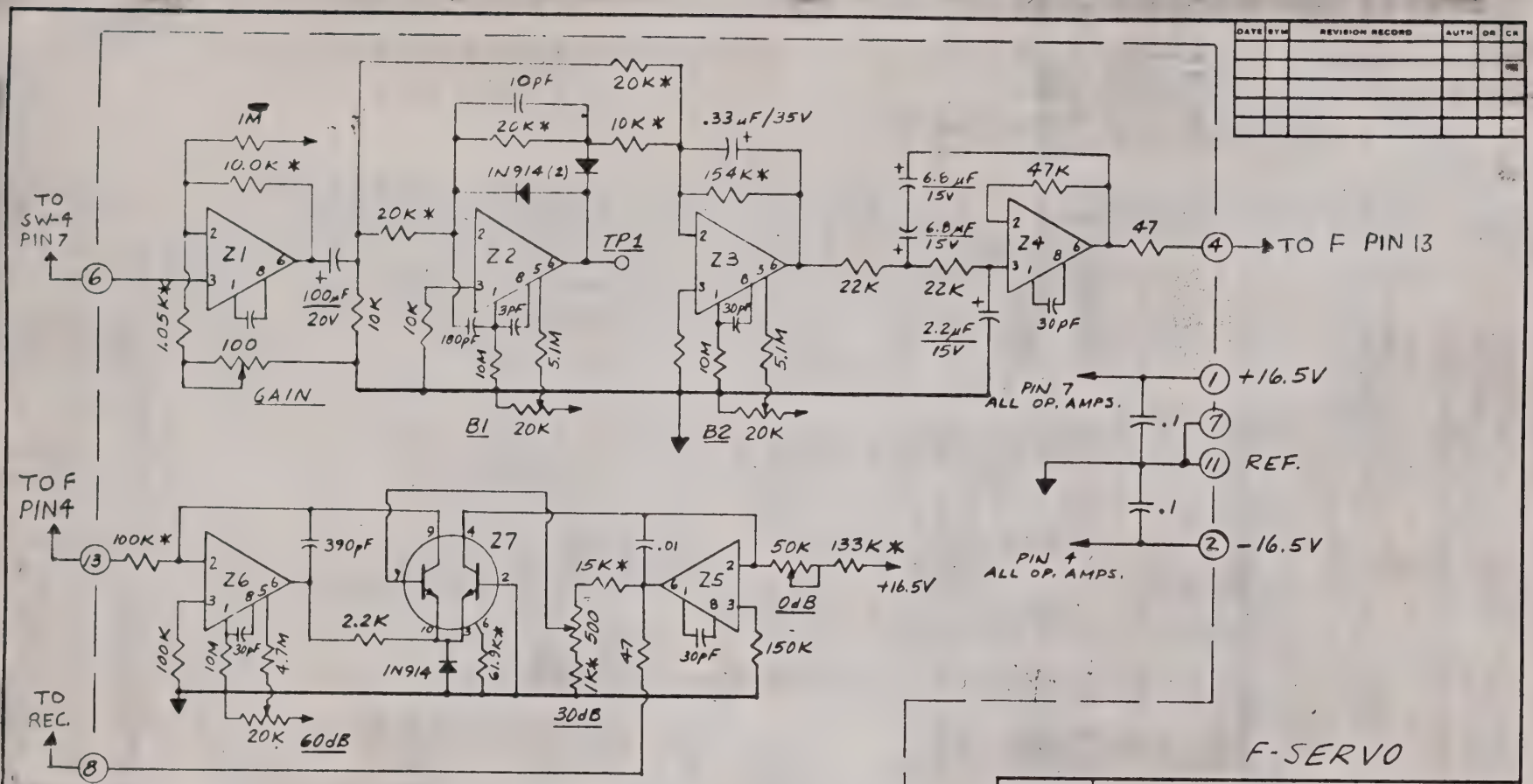
* DENOTES 1% METAL FILM

TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ-DICKIE CORP.		
DECIMAL ±	OSP-4	SCALE	DRAWN BY TU APPROVED BY
FRACTIONAL ±	TITLE COMPONENT LAYOUT POWER SUPPLY CARD		
ANGULAR ±	DATE 7-12-75	DRAWING NUMBER B13822	

PS-OSC-2

FIG 7.45

K·E



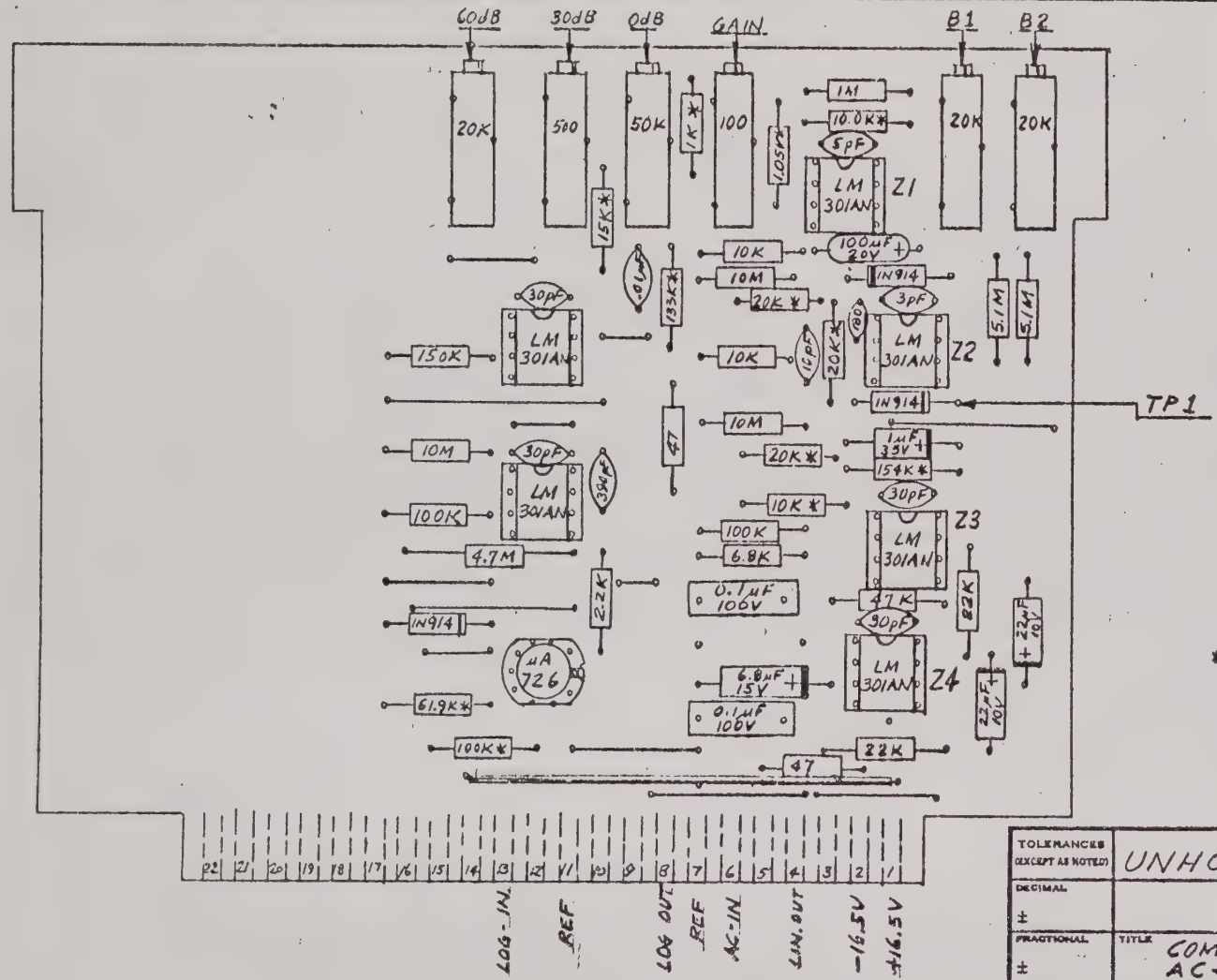
Z1 THRU Z6 : LM301AN
Z7 : µA 726 (PIN 8 - +16.5V ; PIN 5 -16.5V)

F-SERVO

TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ-DICKIE CORP				
DECIMAL ±	OSP-4L	SCALE	DRAWN BY TU		
			APPROVED BY		
FRACTIONAL ±	TITLE CIRCUIT SCHEMATIC AC-LOG DC CONV.				
ANGULAR ±	DATE 8-7-75	DRAWING NUMBER B13743-			

DATE	SYM	REVISION RECORD	AUTH	OR	CK

FIG 7.46



DATE	SYM	REVISION RECORD	AUTH.	DR	CHK.

TOLERANCES (EXCEPT AS NOTED)	UNHOLTZ-DICKIE CORP.		
DECIMAL ±		SCALE	DRAWN BY TU
			APPROVED BY
FRACTIONAL ±	TITLE COMPONENT LAYOUT AC-LOG DC CARD		
ANGULAR ±	DATE 8-4-75	DRAWING NUMBER B 13728	

K+E ALBUQUERQUE 10 5400
MADE IN U.S.A.

8. SPECIFICATIONS

ALL SPECIFICATIONS APPLY AFTER 10 MINUTES WARMUP

1. FREQUENCY

   1.1 Range: 5-5000 Hz
   1.2 Stability: ±1% or 0.5 Hz, whichever is larger for 8 hours in MANUAL or RESET mode.
   1.3 Display: 4-digit counter with .27 in. high LED display. Resolution is 1.0 Hz at a 10 sample/second rate
   1.4 Display Accuracy: ±resolution ±power frequency accuracy

2. AC OUTPUTS

   2.1 Oscillator Output: 1 V rms, ±.5 dB, 5-5000 Hz; Distortion less than 0.3% 20-3000 Hz, less than 0.5% 5-5000 Hz; Output impedance - 100 ohms
   2.2 Compressor Output: 10 V rms max; Distortion less than 0.3% 20-3000 Hz, less than 0.5% 5-5000 Hz, Compressor OFF mode and ON mode, 0-20 dB compression, 10-3000 dB/sec; Output impedance - 50 ohm
   2.3 Charge Output: 10 mV/g, 10 V p max; output impedance - 50 ohm

3. DC OUTPUTS

   3.1 DC ∝ LOG FREQ: 0 - 1.2 V (.4 V/decade); Linearity and stability 0.3 Hz or ±3%
   3.2 DC ∝ FREQ 0 - 10 V (2 mV/Hz); Stability ±2% or 1 Hz.
   3.3 DC ∝ LOG AMPL (OPTIONAL): -3V to 0V (50 mV/dB); Accuracy ±.2 dB 0 to -40 dB, ±.5dB -40 to -60 dB

4. COMPRESSOR (AGC) AMPLIFIER

   4.1 Dynamic Gain Range: greater than 80 dB with compression indicated by front panel meter 0-80 dB
   4.2 Compression Characteristic: Linear from 0 to 70 dB
   4.3 Correction Accuracy: Essentially zero static error 70 dB gain change results in less than 0.1 dB change in test level.
   4.4 Speed: Automatically controlled as a continuous function of frequency from 10 dB/sec at 5 Hz to a switch-selected upper limit of 100, 300, 1000, or 3000 dB/sec at 5 kHz.
   4.5 Turn On: Less than 5 sec from > 80 dB compression to full test level at 5 Hz.
   4.6 Modes (Indicator lights for all modes)
   ON: Compressor active for closed-loop operation. Compressor speed automatically controlled.
   STBY: Compressor output smoothly reduced to more than 80 dB below full output
   LEVEL CAL: Allows closed-loop operation with zero compressor output. Used for occasional calibration and check of operation.
   OFF: Compressor inactive. Compression held at 0 dB.

5. SWEEP OSCILLATOR

   5.1 Sweep Mode - logarithmic - continuous over 3 decades
   5.2 Sweep Time - 1 to 99.9 minutes in 0.1 minute increments. Thumbwheel setting with digital display. Setting is independent of sweep frequency limits. Maximum sweep rate is 3 decades/minute.
   5.3 Sweep Reversal Limits - Each settable with 10 turn controls. Low Limit: 5 to 5000 Hz. High Limit: Low limit to 5,000 Hz
   5.4 Modes (all are pushbutton-actuated)
   SWEEP: Indicates frequency sweep from MANUAL RESET or HOLD mode. Indicator lights for direction.
   REVERSE: Causes reversal of sweep direction.
   HOLD: Stops frequency sweep. Indicator light.
   RESET UP/DOWN: Holds frequency at value determined by upper/lower limit control. Color-indicating pushbuttons.
   MANUAL: Holds frequency at value determined by COARSE and FINE frequency controls. Color-indicating pushbutton.
   5.5 External Sweep - available at rear connector
   5.6 Oscilloscope sweep (Option): Oscilloscope sweep synchronized to 3 periods of oscillator output

6. PROGRAMMER

   6.1 Test Programs: As many as four segments with displacement and acceleration in any combination or sequence. Displacement selection shown by color-indicative pushbutton. Active segment shown by LED indicator.
   6.2 Crossover Frequencies: Independently adjustable 5-5000 Hz.
   6.3 Level Verniers: Ten-turn precision potentiometer with locking dial providing 1% settability of level without presetting operation. Displacement: .001 to .011 in p-p; Acceleration: .1 to 1.1 g peak.
   6.4 Level Multipliers: X10 and X100 with color-indicating pushbuttons usable in any combination providing the following full-scale ranges: Displacement: .01, .1, 1, 10 in p-p. Acceleration: .1, 10, 100, 1000 g p.
   6.5 Vibration Meter: Taut-band movement; 3 in. mirror scale; monitors vibration level of active program segment.
   Accuracy:
   Disp: ±2% of reading ±1% of full scale, 5 to 1000 Hz: (.01 in. range) 50 to 1000 Hz
   Accel: ±1% of reading ±1% of full scale, 5 to 5000 Hz.

7. ACCELERATION SIGNAL

   7.1 Normalized 10 mV/g input - input impedance 47 kilohm
   7.2 Charge Input: Adjustable for sensitivities 1-100 pC/g.

8. INTERLOCKS

   8.1 With compressor ON, MAX. OUTPUT turned CW, STBY mode is established if LEVEL CAL, OFF, A/D, X10, X100, oscillator RESET, or MAN. pushbutton is actuated.
   8.2 With compressor in LEVEL CAL (or OFF) mode and MAX OUTPUT is CW, STBY mode is established if ON, OFF (or LEVEL CAL), oscillator RESET, or MAN pushbutton is actuated.
   8.3 If SERVO goes to STBY for any reason and oscillator is in SWEEP mode, the oscillator automatically goes to HOLD mode.

9. REMOTE CONTROL (OPTIONAL) Separate unit has push-buttons to provide closed-loop operating functions once programmer controls are set. Push-buttons provided: Compressor ON, LEVEL CAL, STBY, SWEEP, REVERSE, HOLD, RESET UP, RESET DOWN. Indicator lights or color indicating buttons are included to indicate active control functions.

10. POWER: 105-125/210-250 VAC 50-60 Hz 40 VA

11. SIZE: 5.25" HIGH x 19" WIDE x 18" DEEP plus cables

TEST EQUIPMENT AND INSTRUMENT INSPECTION
AND
SHIPPING INSTRUCTIONS

1. Unpacking and Inspection

If the shipping carton is damaged, note on acceptance that it is received damaged and subject to claim when inspected. Ask that the carrier's agent be present when the instrument is unpacked and inspected for damage (scratches, dents, broken knobs, etc.). If the instrument is damaged or fails to meet specifications, notify the carrier and the Unholtz-Dickie Corp immediately. Retain the shipping carton and the padding material for possible return for repair or further inspection by carrier. The purchaser and Unholz-Dickie Corp will arrange for the replacement and/or repair of the damaged item.

2. Storage and Shipment

Return Shipment Procedure: Please be sure the following instructions are observed if for any reason the item is being shipped back to Unholtz-Dickie for repair or replacement.

A. Packing: To protect valuable electronic equipment during storage or shipment, always use the best packaging methods available. Unholtz-Dickie can provide packing material such as that used for original factory packaging. Contract packaging companies in many cities can provide dependable custom packaging on short notice. Here are a few recommended packaging methods:

(1) Original - Place instrument in original container. Replace all packing pads and fillers in the exact position which they originally occupied. If original packing is no longer available, use 2 inch thick foam rubber padding.

(2) Rubberized Hair - Cover painted surfaces of instrument with protective wrapping paper or plastic bag. Pack instrument securely in strong corrugated container, double wall (350 lb/sq in minimum bursting test) with 2 inch rubberized hair pads placed along all surfaces of the instrument. Insert fillers between pads and containers to ensure a snug fit.

(3) Excelsior - Cover painted surfaces of instrument with protective wrapping paper or plastic bag. Pack instrument in strong corrugated container, double wall (350 lb/sq in minimum bursting test) with a layer of excelsior about 6 inches thick packed firmly against all surfaces of the instrument.

B. Environment: Conditions during storage and shipment should normally be limited as follows:

(1) Minimum Temperature: -40°F. (-40°C)

(2) Maximum Temperature: 167°F. ($+75^{\circ}$C)

(3) Maximum Average Humidity: Less than 70%

3. Systems shipped in winter are normally flushed with antifreeze.

MP MASTER
MA33277

UNHOLTZ-DICKIE CORPORATION
BARNES INDUSTRIAL PARK NORTH ■ 6 BROOKSIDE DRIVE, WALLINGFORD, CONNECTICUT 06492 ■ (203)265-3929